INTERN EXPERIENCE WITH TEXAS UTILITIES SERVICES INC.

AN INTERNSHIP REPORT

by

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ABSTRACT

Intern Experience with Texas Utilities

Services Inc. (May 1978)

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This report is a review of the author's year of experience as an intern with Texas Utilities Services Inc. The intent of the report is to demonstrate that this experience fulfills the requirements for the Doctor of Engineering internship.

The author worked as a Nuclear Fuels Engineer for the duration of the internship period. His primary assignment was the development of a system to facilitate the financial accounting and materials accountability for nuclear fuel. This assignment required the author to coordinate the design process with many people from different disciplines. In addition, the author was responsible for performing financial and economic analyses of the nuclear fuel cycle. This offered him the opportunity to evaluate the economic impact of various engineering and financial decisions upon the nuclear fuel cycle.

DEDICATION

TO GAIL

ACKNOWLEDGMENTS

The author wishes to thank the following people for their support and help in attaining his goals:

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INTRODUCTION

Doctor of Engineering Internship

The internship experience is an important integral part of the Doctor of Engineering program. The objectives of the internship are:

a. to enable the student to demonstrate his ability to apply his knowledge and technical training by making an identifiable engineering contribution in an area of practical concern to the organization or industry in which the internship is served, and

b. to enable the student to function in a non-academic environment in a position where he will become aware of the organizational approach to problems in addition to traditional engineering design or analysis.[1]

Within this general framework I then developed a set of objectives relating specifically to my internship as a Nuclear Fuels Engineer with Texas Utilities Services Inc. These objectives are included as Appendix A.

Texas Utilities Company System

The Texas Utilities Company System is an investor-owned electric utility system that includes three electric utilities, two resource development companies, a fuel company, a generating company and a service company. The three electric utilities: Dallas Power & Light Company (DP&L), Texas Electric Service Company (TESCO), and Texas Power & Light Company (TP&L) supply electric power to over four million people within a 75,000 square mile service area in north-central, east and west Texas. Chaco Energy Company, a wholly owned subsidiary incorporated in New Mexico is responsible for the development of energy resources, primarily coal and uranium, for the use of the System companies. Basic Resources Inc. is the Texas subsidiary responsible for resource development. Texas Utilities Fuel Company (TUFCO) owns a natural gas pipeline system and acquires, stores and delivers fuel gas and oil and provides other fuel services to the System companies. Texas Utilities Generating Company (TUGCO) acts as agent for the three electric utilities in the operation of their jointly-owned lignite and nuclear generating stations. Texas Utilities Services Inc. (TUSI) furnishes engineering, construction management, financial and other services to the System companies.

Comanche Peak Steam Electric Station

The Comanche Peak Steam Electric Station (CPSES) is a two-unit nuclear power plant currently under construction near Glen Rose, Texas. TUGCO plans to begin the commercial operation of Unit 1 in early 1981. Each unit contains a Westinghouse pressurized water reactor (PWR) with a nominally-rated power output of 1150 MWe. TUSI is providing construction management services through the Nuclear Plants Division of its Engineering and

Construction Department. Nuclear fuel services are provided by the Nuclear Fuel Section within the Nuclear Plants Division.

<u>Nuclear Fuel Section</u>

An abbreviated organizational chart for TUSI's Engineering and Construction Department, giving the location of the Nuclear Fuel Section, is shown in Figure 1. The Nuclear Fuels Supervisor is Richard Calder, who was also my internship supervisor. The section is responsible for all evaluation, planning, procurement and administrative activities associated with the nuclear fuel cycle. These responsibilities include:

1. Administrating nuclear fuel contracts.
2. Developing and maintaining computer programs and analytical methods for calculations and assessment of the nuclear fuel performance prior to insertion and during residency in the core.
3. Coordinating, with the accounting department, the development of computer programs and procedures to provide accurate records of all nuclear fuel for materials accountability and financial accounting purposes.
4. Providing technical assistance to nuclear engineers at the plant in performing safety analysis and other fuel related calculations.
5. Performing in-depth calculations beyond the capability of plant facilities for nuclear fuel performance and safety analysis.
6. Coordinating with System Planning and Comanche Peak Steam Electric Station personnel to determine fuel loading and refueling schedule for the operating requirements of the plant.
7. Providing project management for joint uranium ventures.[2]

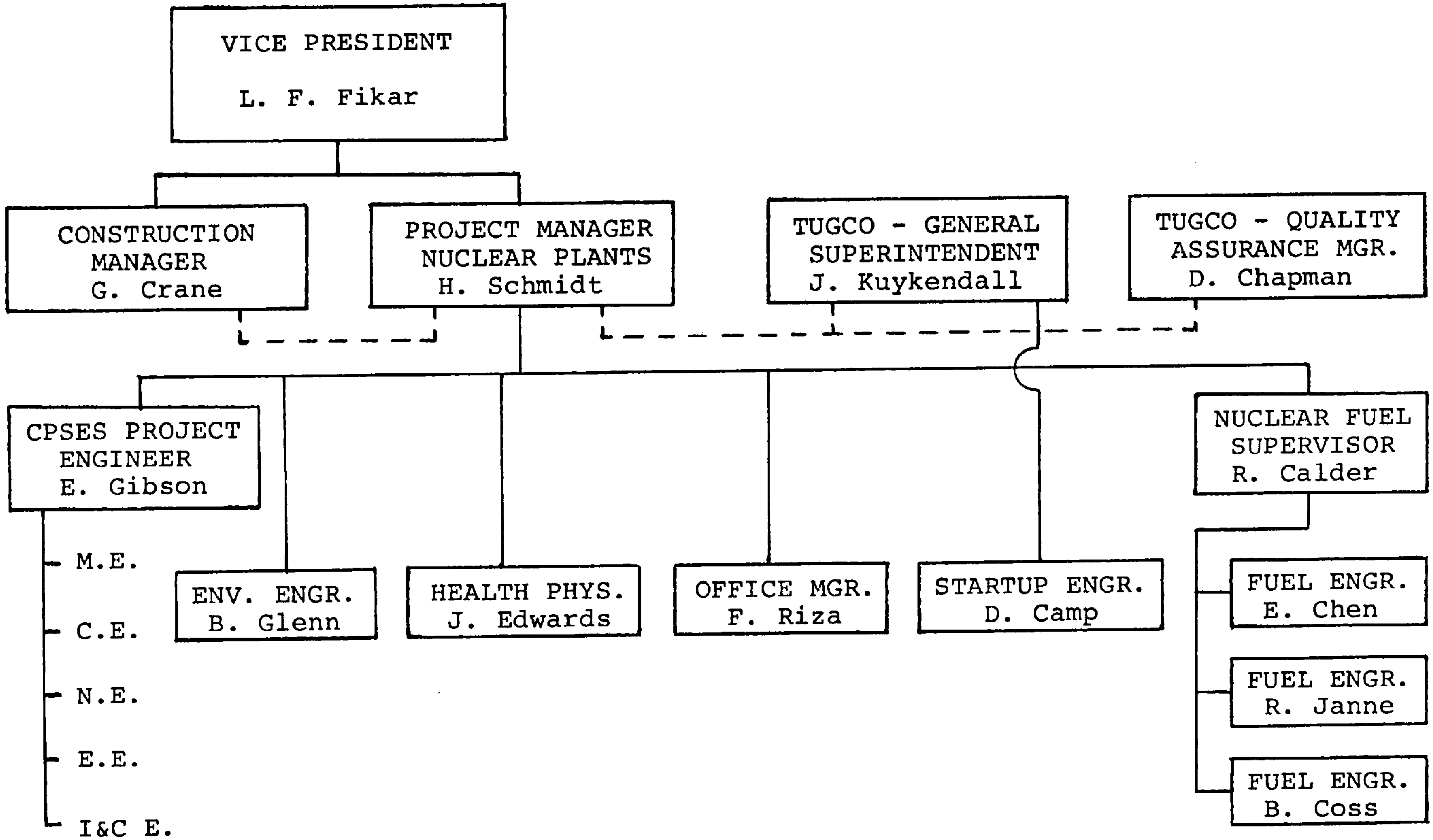

Fig. 1. Organizational Chart for TUSI Engineering & Construction Department - Nuclear Plants Division

Nuclear Fuel Cycle Overview

The nuclear fuel cycle utilized by the Westinghouse PWR for the Comanche Peak plant is illustrated in Figure 2. The uranium-bearing ore is concentrated by a solvent-extraction process at a mill, usually located at the mine. The mill typically produces ammonium diuranate in the form of a yellow powder, also known as "yellow-cake" or "concentrates." The yellow-cake material is then converted to uranium hexafluoride (UF_6), a white solid which sublimes at 54.6°C (130.3°F).[3]

Naturally occurring uranium consists primarily of two isotopes, U-235 (.71%) and U-238 (99.28%). For use as fuel in a PWR the concentration of U-235 must be increased to around 3%. In the U.S. this service is provided by the Department of Energy at one of its enrichment plants. Natural uranium in UF_6 form is enriched to the required concentration through a gaseous diffusion process.

The enriched uranium in UF_6 form is then shipped to the fabricator for final processing. The UF_6 is converted to uranium dioxide (UO_2), a material which is formed into small ceramic pellets and loaded into 12 foot long fuel rods made of Zircaloy-4 tubing. A complete reactor core consists of over 50,000 fuel rods contained in 193 fuel assemblies. These are arranged to approximate a

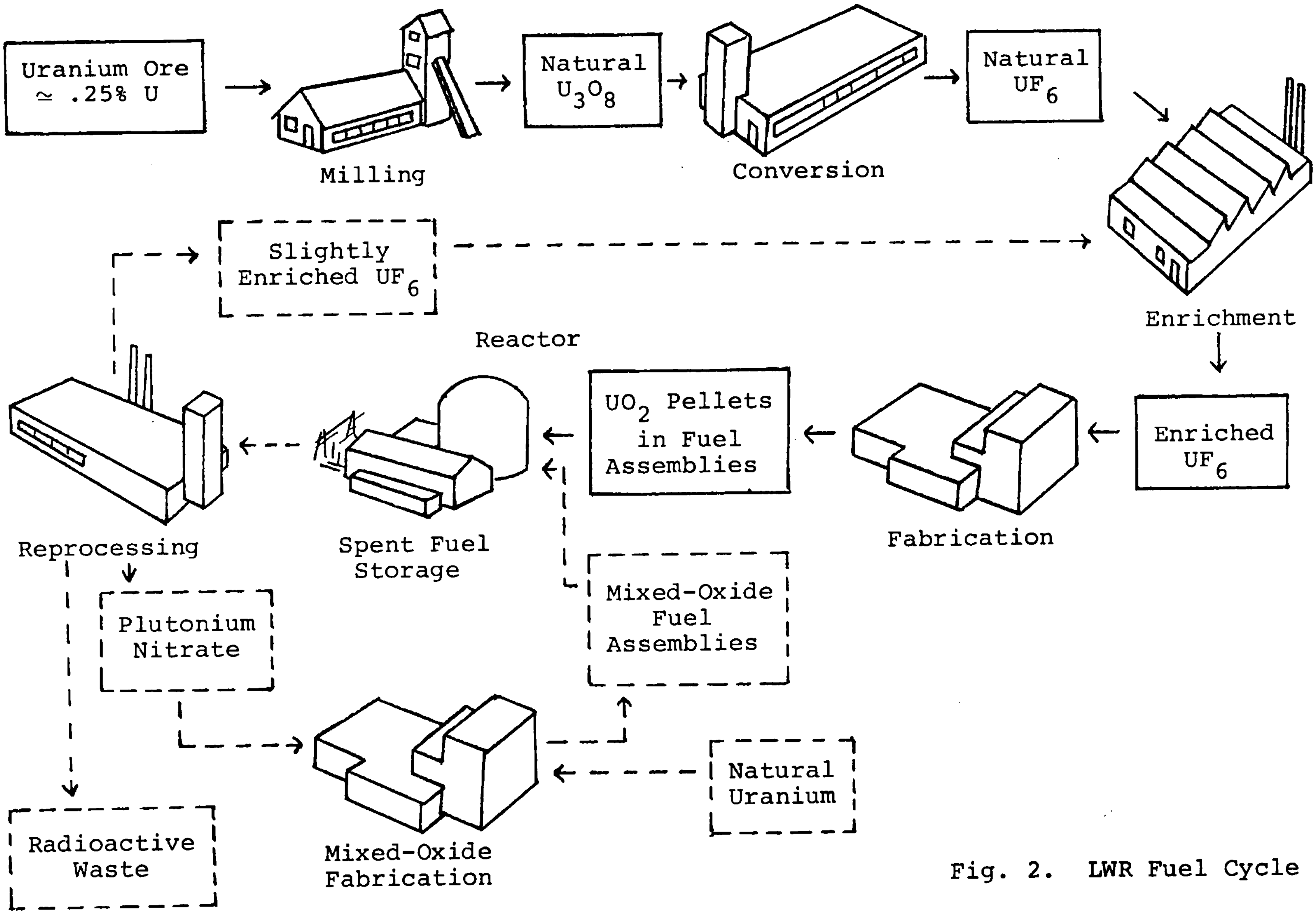

Fig. 2. LWR Fuel Cycle

cylinder 11 feet in diameter by 12 feet long. The total amount of uranium contained in a new reactor core is over 88 metric tons.

After a period of operation, usually between 12 and 18 months, new fuel is needed to replace the uranium which has been depleted through the fission process. Normally, about one-third of the fuel assemblies are replaced during each refueling. The spent fuel which is removed from the reactor is highly radioactive and is stored underwater at the plant for a minimum of 3 months while much of the highly radioactive fission products decay away.

Currently there is a considerable amount of uncertainty about the continuation of the fuel cycle from the spent fuel stage. As originally conceived, the spent fuel would then be shipped to a reprocessing plant where the remaining uranium would be separated out, converted to UF_6 and recycled. The plutonium which is produced during fission could also be recovered, converted to plutonium oxide and then mixed with UO_2 for fabrication into mixed-oxide fuel. The fission products would be sent to a waste treatment facility for disposal. The Carter Administration, however, has imposed a moratorium on all fuel reprocessing and most utilities are faced with the possibility of a once-through or "throwaway" fuel cycle in which the spent fuel assemblies are disposed of without recovery of the available uranium and plutonium. Eliminating this valuable fuel resource will have a significant impact upon fuel economics. At present most utilities are expanding their spent fuel storage capacity and waiting for the government to establish a definite policy toward fuel recycling.

With or without reprocessing, the nuclear fuel cycle spans a considerable amount of time. The approximate time required for each step in the cycle is shown in Table I.

TABLE I

Time Required for Steps in the Nuclear Fuel Cycle

Mining and Milling	3 months
Conversion	3 months
Enrichment	3 months
Fabrication	6 months
Power Production	36 months
Spent Fuel Cooling	4 months
Spent Fuel Shipping	2 months
Reprocessing	4 months
Total:	61 months

NUCLEAR FUEL ACCOUNTING

Texas Utilities felt that the unique combination of skills provided me by the Doctor of Engineering curriculum could best be utilized by assigning to me the project of developing a Nuclear Fuel Accounting System. The problem had not been considered by the company much beyond the point of recognizing that such a system would be needed when the Comanche Peak Station became operational. I decided that to benefit from discussions with other utilities working on the problem, I would need a thorough understanding of the appropriate Federal Power Commission guidelines as well as some awareness of the current problems in this area. My first consideration, therefore, was to learn as much as possible about nuclear fuel accounting from the available literature.

Federal Power Commission Guidelines

The Federal Power Commission (FPC) Uniform System of Accounts prescribes a set of accounts to be used by the electric utility for the recording of nuclear fuel during the fuel cycle.[4] These accounts are described briefly in Table II. A more complete description is given in Appendix B.

The important difference between nuclear fuel and the traditional (fossil) fuels used by utilities is that

TABLE II

FPC Accounts Applicable to Nuclear Fuel

Account Number	Title and Description
120.1	Nuclear Fuel in Process of Refinement, Conversion, Enrichment and Fabrication - original cost of materials - salvage value of recovered materials in process of fabrication - processing costs - interest, insurance and taxes during processing - shipping, handling and storage costs - Quality Assurance costs
120.2	Nuclear Fuel Materials and Assemblies -- Stock Account - original cost of fabricated fuel assemblies delivered for use - original cost of partially irradiated fuel assemblies held for reinsertion - original cost of all other materials held for future use and not in process
120.3	Nuclear Fuel Assemblies in Reactor - original cost of all nuclear fuel assemblies currently in the reactor
120.4	Spent Nuclear Fuel - original cost of all nuclear fuel assemblies that are cooling pending reprocessing
120.5	Accumulated Provision for Amortization of Nuclear Fuel Assemblies - amortization of the net cost of nuclear fuel assemblies used in the production of energy
157	Nuclear Materials Held for Sale - net salvage value of recovered nuclear materials that are not to be reused by the utility
518	Nuclear Fuel Expense - charges for the amortization of the net cost of nuclear fuel assemblies used in the production of energy

nuclear fuel is considered a fixed asset whereas fossil fuel inventories are current assets. The FPC Uniform System of Accounts, therefore, provides for the treatment of nuclear fuel as a fixed asset which must be depreciated over its useful lifetime to its net salvage value. Utility regulatory agencies have historically allowed utilities to include in their rate bases only those assets which are currently used in the generation of electricity. In other words, the customer does not bear the cost of a new asset until it is actually being used to generate the electricity he is using. Therefore, the cost of funds used to finance the construction of a new asset is added to the total cost of that asset. This interest cost is usually referred to as the Allowance for Funds Used During Construction (AFUDC). Being a fixed asset, the cost of nuclear fuel will also include an associated AFUDC.

The basic procedure for accounting for nuclear fuel as specified by the FPC is discussed below. The flow chart in Figure 3 gives an overall view of the relationship of the FPC accounts appropriate to nuclear fuel.

Account 120.1 - Nuclear Fuel in Process of Refinement, Conversion, Enrichment and Fabrication

This account accumulates the original cost of completed fuel. This is generally done on a "batch" basis,

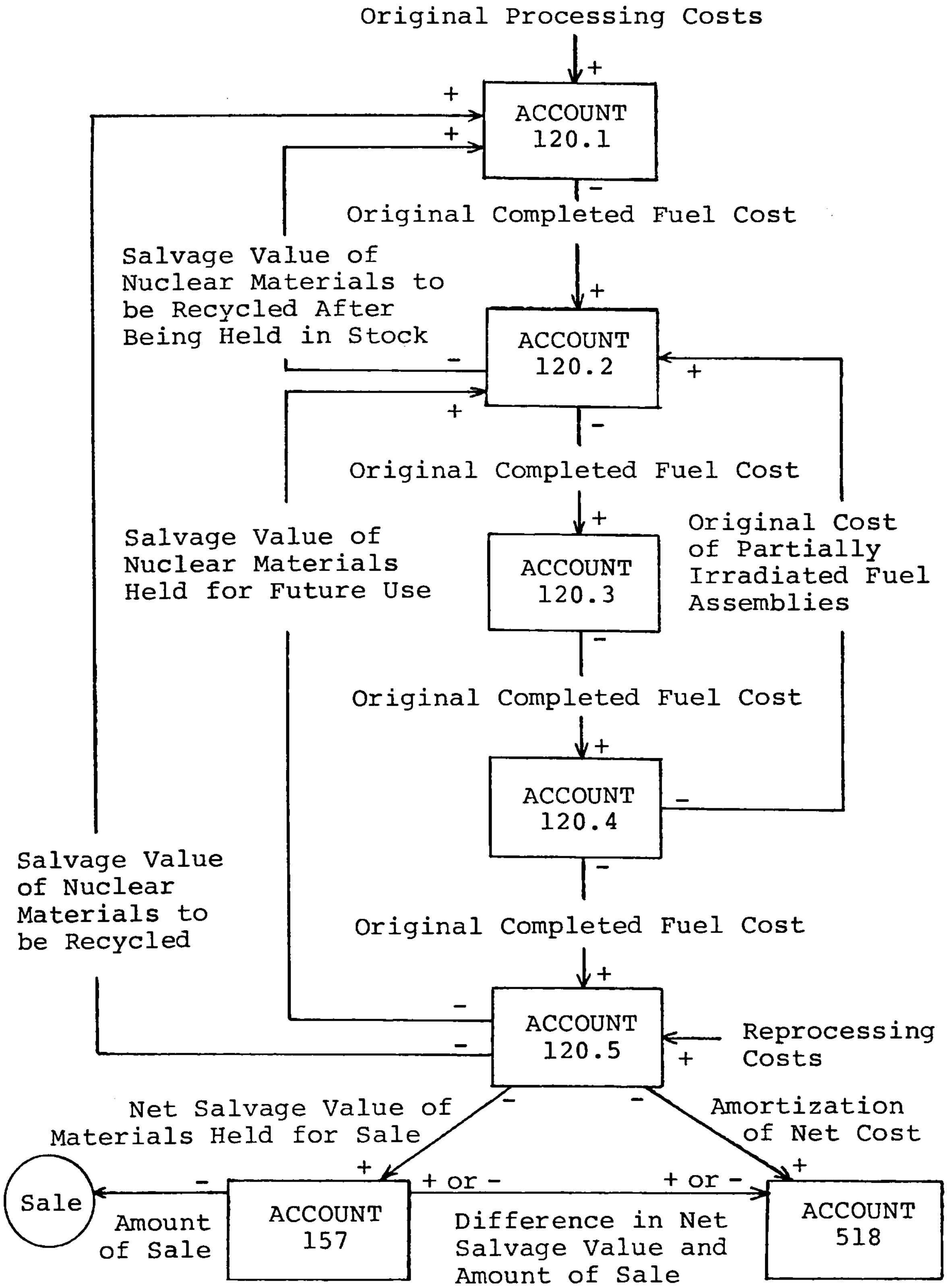

Fig. 3. Flow Chart of Nuclear Fuel Accounts

where "batch" refers to a load of nuclear fuel of a specified enrichment. An initial core contains three batches of fuel. The major components of the original cost include the cost of raw materials and processes such as milling, conversion, enrichment and fabrication. Also charged to Account 120.1 are AFUDC, insurance and taxes during processing. The salvage value, including reprocessing costs, of any recovered nuclear materials which are incorporated into a new batch of fuel is also charged to Account 120.1.

When the final charges to a particular batch of fuel are paid, the total original cost of that batch of fuel is credited to Account 120.1 and debited to Account 120.2, or in the case of the initial core, to Account 120.3. In addition, the total batch cost is now unitized to a cost per assembly basis for the purpose of accurate ammortization of the fuel cost.

Account 120.2 - Nuclear Fuel Materials and Assemblies - Stock Account

As nuclear fuel moves through the fuel cycle, the value assigned to it also moves through the accounting system. Account 120.2 is debited for the total original cost of all new fuel assemblies which have been received from the fabricator and are awaiting insertion into the reactor. Also included in Account 120.2 is the total original cost of all spare assemblies and any partially irradiated assemblies which may be reinserted into the reactor. Finally, Account 120.2 also includes all nuclear materials held for future use but not actually in process. When assemblies are inserted into the reactor core the total original cost of those assemblies is credited to Account 120.2 and debited to Account 120.3.

Account 120.3 - Nuclear Fuel Assemblies in Reactor

The total original cost for the initial core is closed directly from Account 120.1 into Account 120.3. For all future reload batches the total original cost, which has been closed to Account 120.2 while awaiting insertion into the reactor, will be closed to Account 120.3 upon the completion of refueling. The total original cost of the spent fuel removed during refueling will be credited to Account 120.3 and debited to Account 120.4.

Account 120.4 - Spent Nuclear Fuel

The total original cost of the spent nuclear fuel assemblies removed from the reactor during refueling is closed to Account 120.4 from Account 120.3. The total original cost of partially irradiated assemblies which may be reinserted is then credited to Account 120.4 and debited to Account 120.2. When spent fuel assemblies are shipped for reprocessing, the total original cost of these assemblies is credited to Account 120.4 and debited to Account 120.5.

<u>Account 120.5 - Accumulated Provision for Amortization of Nuclear Fuel Assemblies</u>

This account contains the accumulated amortization of the nuclear fuel assemblies in the reactor. While the nuclear fuel assemblies are in the reactor, the net cost of the nuclear fuel is amortized over the energy produced by those assemblies. The monthly amortization for each assembly in the reactor is credited to this account and debited to Account 518. The amortization is calculated for each assembly based on the amount of energy produced by each assembly during the month. The monthly energy production of each assembly is determined by a computer model of the reactor core based on actual data obtained throughout the month from monitoring certain core parameters.

The equation for determining the amortization is:

$$ACM = \left[\frac{TOC + ERC - ESV - ARD}{ELB - ABD}\right] \times BCM$$

where

ACM = Amortization for the Current Month

TOC = Total Original Cost

ERC = Estimated Reprocessing Cost

ESV = Estimated Salvage Value

ARD = Amortization Recorded to Date

ELB = Estimated Lifetime Burnup

ABD = Actual Burnup to Date

BCM = Burnup for Current Month

Nuclear fuel burnup, although normally expressed in Megawatt Days per Metric Ton Heavy Metal, may be expressed in any convenient equivalent form such as Thermal Megawatt Hours or Million BTU's. The term inside the brackets represents the remaining cost per unit of burnup which, when multiplied by the burnup for the current month, yields the amount of the fuel cost amortized during the month. This amortization of nuclear fuel costs is analogous to the depreciation of other fixed assets. The net book value of the nuclear fuel in the reactor can be found at any time by adding the balance of Account 120.5 to that of 120.3.

Note that three components of the amortization equation are estimated values. Continuous evaluation of these parameters and timely readjustments of the estimates are necessary to avoid overstating (or understating) the nuclear fuel expense. Failure to do so could result in undesirably large adjustments to Account 518 in the future.

When spent fuel assemblies are shipped for reprocessing Account 120.5 becomes the closing account. The total original cost of the fuel assemblies shipped is credited to Account 120.4 and debited to Account 120.5. When reprocessing charges are paid they are debited to Account 120.5. Account 120.5 is credited for the salvage value of recovered nuclear materials when such materials are sold, transferred or disposed of otherwise. Account 120.1 is debited for the salvage value of recovered nuclear materials used in the manufacture of new fuel assemblies. Account 120.2 is debited for the salvage value of recovered nuclear materials to be held for future use but not actually in process. Account 157 is debited for the salvage value of recovered nuclear material to be sold.

After these transactions are completed, any remaining small balance in Account 120.5 will be expensed directly to Account 518. If the remaining balance is so large that it would distort current month expenses, it may be closed to a separate clearing account and then amortized to Account 518. This should not be necessary if the estimated parameters mentioned above are reasonably accurate.

Account 157 - Nuclear Materials Held for Sale

The salvage value of recovered nuclear material which is to be sold is credited to Account 120.5 and debited to Account 157. At the time of the sale the actual sale value of the material will be credited to Account 157 and debited to cash. Any balance left in Account 157 after the sale is adjusted to Account 518.

Account 518 - Nuclear Fuel Expense

The monthly amortization of nuclear fuel based on the energy produced is debited to Account 518 and credited to Account 120.5. Account 518 represents the net cost of nuclear fuel used to generate electricity during the month. Dividing the amount in Account 518 by the net kilowatt-hours of electricity generated yields the monthly nuclear fuel cost in mills/kwh.

Figure 4 further illustrates the relationship of the FPC nuclear fuel accounts by depicting the changing balances in these accounts for a particular batch of fuel throughout the fuel cycle. The last graph in Figure 4 represents the net book value of the nuclear fuel throughout the fuel cycle.

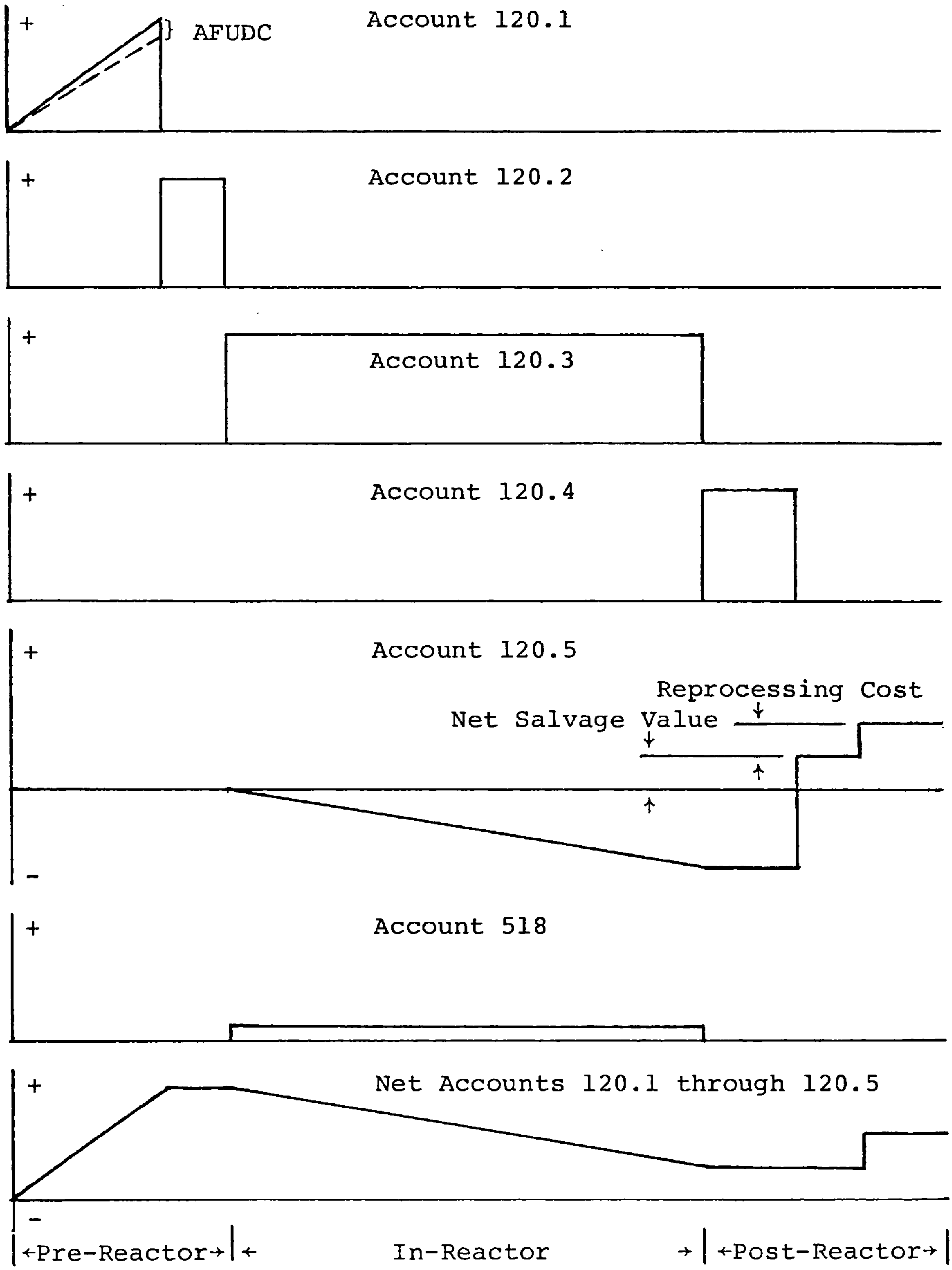

Fig. 4. Status of Nuclear Fuel Accounts During the Fuel Cycle - with AFUDC and Reprocessing

Current Problems in Accounting for Nuclear Fuel

The current economic and political climate has precipitated several problems in the area of nuclear fuel accounting. These are centered about three major issues: 1) the inclusion of nuclear fuel in process (NFIP) in the rate base; 2) the inclusion of nuclear fuel costs in the Fuel Adjustment Clause; and 3) the inability to estimate accurately the salvage value of nuclear fuel materials.

Including NFIP in the Rate Base

The increasing cost of obtaining capital combined with the rapidly escalating cost of fuel materials and services has resulted in a significant increase in the share of fuel costs allotted to AFUDC. Although including Nuclear Fuel in Process in the rate base means that the utility is earning a return on an asset which is not currently producing power, the net effect is a lower total cost over time to the customers through the elimination of the AFUDC component of nuclear fuel cost. Several state utility commissions now permit the inclusion of some or all NFIP as well as Construction Work in Progress (CWIP) in the rate base. However in some states only certain items within Account 120.1, such as advance payments, have been allowed in the rate base.[5]

Nuclear Fuel Costs in Fuel Adjustment Clauses

The general impact of including nuclear fuel costs is a reduction in the fuel cost adjustment at the very time the utility is experiencing the much higher capital costs associated with a nuclear power plant. In at least one state nuclear fuel costs are expressly excluded from the Fuel Adjustment Clause. In several other states the inclusion of nuclear fuel costs is permitted, but not required. Still other states, and the FPC, require nuclear fuel costs to be included in the Fuel Adjustment Clause for utilities under their jurisdiction. They maintain that the higher capital costs associated with nuclear fuel generation should be reflected in the filing of a major rate change rather than the Fuel Adjustment Clause.[5]

Estimating the Salvage Value

Until recently, most utilities, in accordance with the policy outlined in the FPC Uniform System of Accounts, estimated reprocessing costs and the salvage values of the plutonium and uranium to be recovered from spent fuel. Even for those utilities which had reprocessing contracts, this was a difficult task because most of those contracts had escalation clauses tied to various economic indicators. In addition, the market for recovered plutonium was extremely questionable. As a result, the utilities really did not know whether they were overcharging or undercharging their customers for the electricity they were using.

With the imposition of an indefinite deferral of commercial reprocessing, however, the difficult task of accurately estimating salvage values becomes impossible. The primary responsibility of the utility is to recover all of its nuclear fuel costs without overcharging the customer. If the utility assumes that it will reprocess fuel but later is told to dispose of it, it is not clear what recourse is available to the utility to completely recover its fuel costs. On the other hand, if the utility assumes a once-through fuel cycle with an associated disposal cost and the fuel is later reprocessed and found to have a positive salvage value, then the customer has been unjustly overcharged.

Due to increasing uncertainty about reprocessing many states are now assuming a zero net salvage value for nuclear fuel. Some states are allowing the more conservative assumption of a negative net salvage value, i.e., a cost of disposal is assigned to nuclear fuel. In those cases the utilities are required to justify whatever negative salvage value they have chosen. In addition, many do not allow a change in the estimated salvage value to be reflected in the Fuel Adjustment Clause. These changes may only be considered in major rate cases.[5]

If NFIP is included in the rate base and a negative net salvage value is assumed, the status of the FPC accounts throughout the fuel cycle is that shown in Figure 5. Note that the net book value is zero after final disposal.

System Development

Given the current economic and political uncertainties and the fact that Texas' newly-formed Public Utilities Commission had no established precedents in this area, flexibility quickly became the major consideration in developing a nuclear fuel accounting system. A discussion with the company accountants indicated that they also considered flexibility of prime importance. The company was in the process of implementing a new inventory management system, and it was suggested that the accumulation of costs in Account 120.1 could probably be accomplished with this system. This development, coupled with the expectation that the reprocessing/disposal issue would not be resolved until the late 1980's, resulted in focusing the scope of the system primarily on accounting for nuclear fuel assemblies while at the plant-site. The general requirements established for the system are given

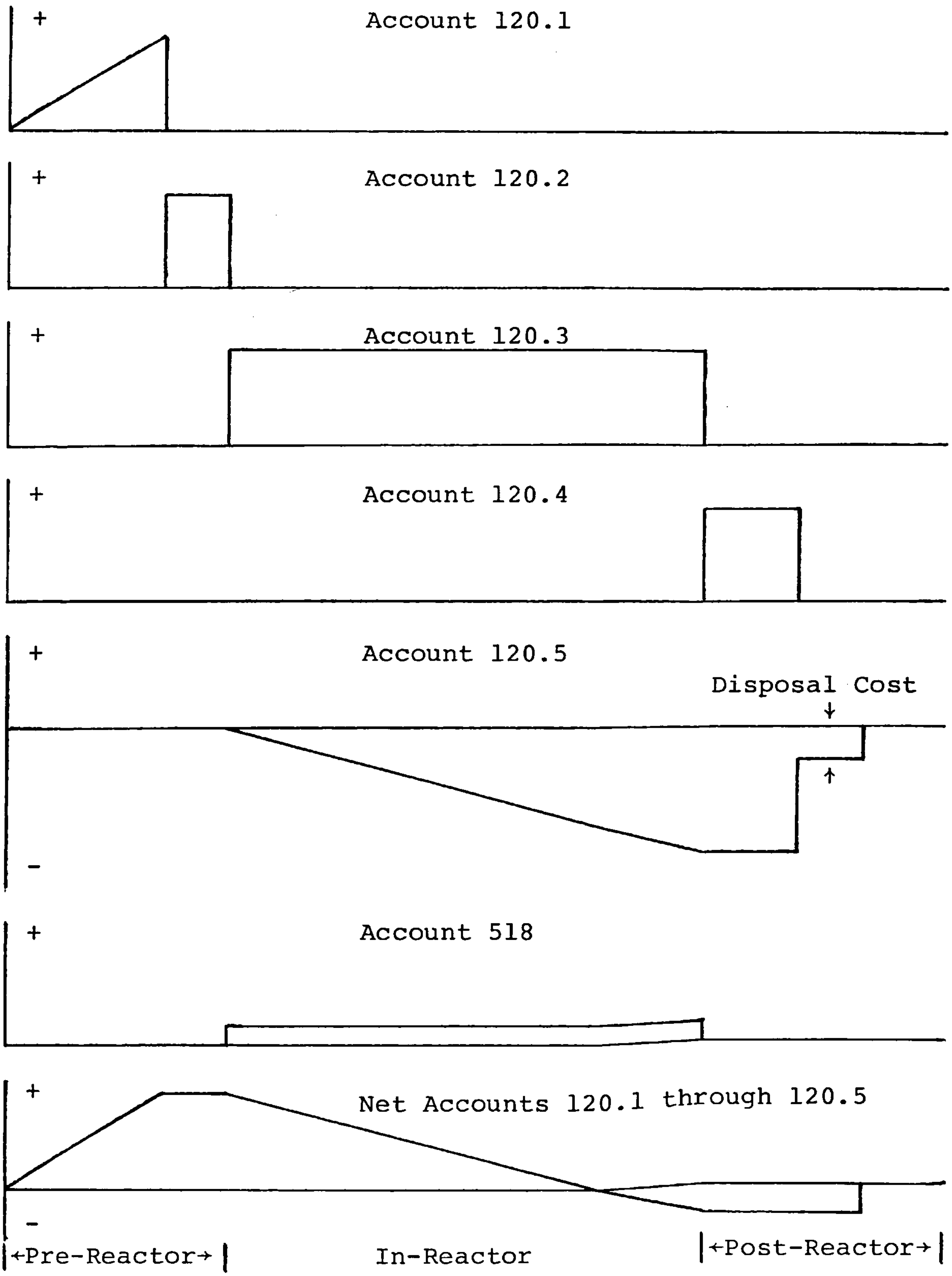

Fig. 5. Status of Nuclear Fuel Accounts During the Fuel Cycle - with Negative Salvage Value and No AFUDC

in Table III. Because of their heavy involvement in several, more current problems, the accountants were quite willing for me to pursue the development of the system on my own.

Survey of Available Systems

Having established the basic requirements of the system, the next step was to determine what types of nuclear fuel accounting programs were readily available at what cost. Most of the utilities contacted were either just beginning to develop or had completed "in-house" development of their own computerized nuclear fuel accounting systems. Many of these were developed piece-meal as the need arose and, as a result, were rather inflexible.

Two utilities, Philadelphia Electric Company and Commonwealth Edison Company, had programs developed for them by outside vendors. NAIPE, the program developed for Philadelphia Electric by Nuclear Associates International, a Control Data Corporation subsidiary, was an attempt to combine a fuel accounting program with an economic analysis program. Several test runs of NAIPE, through the Dallas CDC office, demonstrated that it was unsuitable as an accounting program, primarily because it treated the fuel on a batch basis rather than on an

TABLE III

Requirements for a Nuclear Fuel Accounting System

1. The system should comply with the FPC Uniform System of Accounts.

2. The basic unit of record within the system should be the fuel assembly.

3. The AFUDC component of original cost for each assembly should be readily available.

4. The exact location of each fuel assembly at the plant should be readily available. A record of all movements within the plant should be kept for each assembly.

5. All changes in estimated salvage values, reprocessing/disposal costs, and expected lifetime burnup should be recorded for each assembly.

6. A record of the monthly fuel burnup and associated amortization should be kept for each assembly.

7. The system should provide monthly reports of fuel burnup and associated amortization for each assembly and also the totals for each plant.

8. The system should provide other reports as needed to reflect changes in the status of the other FPC Accounts.

9. The system should accept, as input data, the output from the vendor-supplied programs for fuel burnup calculations.

10. The system should be readily expandable to accomodate plants at several different locations.

11. The system should include the necessary controls, editing and file maintenance routines to ensure an error-free data base.

assembly basis. The Nuclear Fuel Data Base (NFDB) and the Nuclear Fuel Accounting System (NUFACS) made up the system developed for Commonwealth Edison by Energy Management Associates (EMA). A study of the user's manuals indicated that they were very comprehensive programs with a great deal of flexibility. However, EMA was asking approximately $250,000 for the software package.

Three other utilities, Tennessee Valley Authority (TVA), Duke Power Company and Virginia Electric and Power Company (VEPCO), indicated in their communications with me that they each had fairly well-developed, comprehensive programs which were available free of charge if I felt that we could use them. I then made a trip to each of these companies to evaluate each of their systems. The VEPCO system was clearly the most comprehensive and flexible of the three. It was well-documented and appeared to be comparable in size and scope to the NFDB/NUFACS system.

The VEPCO Nuclear Fuel Accounting System

At this point it was decided to try to implement the VEPCO system on our own computer. Due to the difficulties encountered in obtaining a readable tape copy of the VEPCO software package, I was unable to complete this step before the end of my internship. However, I feel that the VEPCO system is a superior nuclear fuel accounting program which TUSI should be able to use with some modification. In addition to a copy of all the component programs, VEPCO supplied a system specifications manual, a user's manual, copies of their accounting procedures and forms for the associated paper work.

The nuclear fuel accounting system is designed around an extensive data base which maintains a complete history of each fuel assembly. Each data record contains such information as changes in the location of the assembly within the reactor core and the fuel storage pool, monthly fuel burnup, changes in the estimated lifetime burnup, changes in the estimated salvage value and reprocessing/disposal costs, monthly amortization, cumulative burnup and cumulative amortization. The date each change was entered is also recorded.

A flow chart for the file maintenance programs, which enter new transactions and other changes to the data base, is shown in Figure 6. Cards containing the coded transactions are submitted to an editing program which checks for most keypunch errors. When all the errors have been eliminated a sorted transaction file is written on magnetic tape. This tape is then submitted to an updating program. A control program is called which reads the transaction file and a control file and

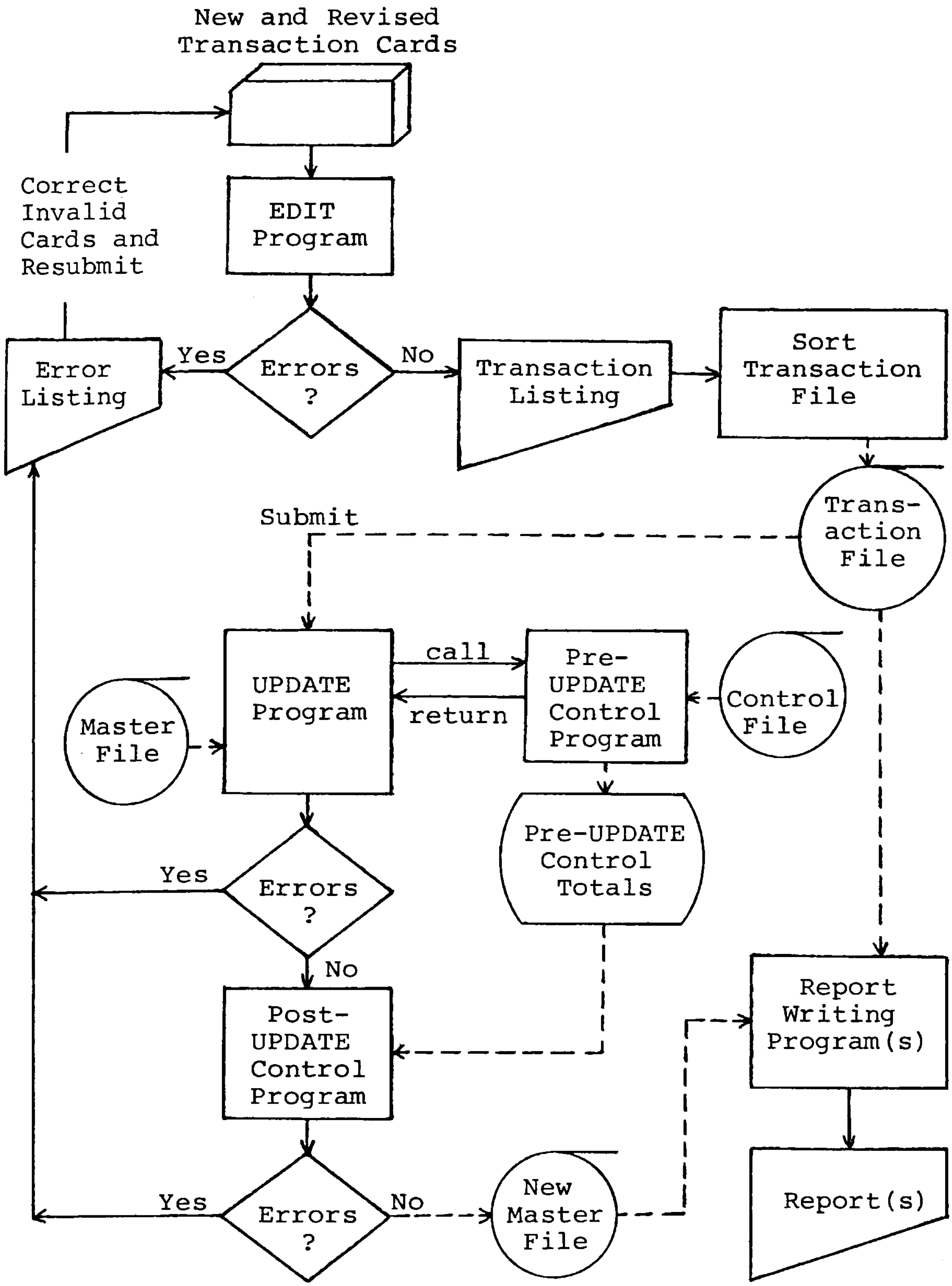

Fig. 6. VEPCO NFA System - Processing Flow Chart for Input of New Transactions and Routine File Maintenance

generates a set of pre-updating control totals. After a successful update is executed, another control program generates a set of post-updating control totals and compares them with the pre-updating set. If the two sets agree, then an updated master file reflecting the new transactions is written on magnetic tape and any user-specified reports are printed.

At the end of each month the fuel burnup must be entered into the system for amortization calculations. The flow chart for this process is shown in Figure 7. Since VEPCO has four Westinghouse reactors, the system is designed to accept burnup data from INCORE and TOTE, the standard Westinghouse software package for fuel burnup calculations. Upon successful translation of the TOTE data, the burnup records are written on magnetic tape. This tape is then submitted to an amortization program which adds the burnup data and the calculated amortization charges to the master file. Control programs similar to those used by the file maintenance programs will detect invalid data. Upon successful execution of the program, reports of the calculated charges are printed for posting to the accounting records.

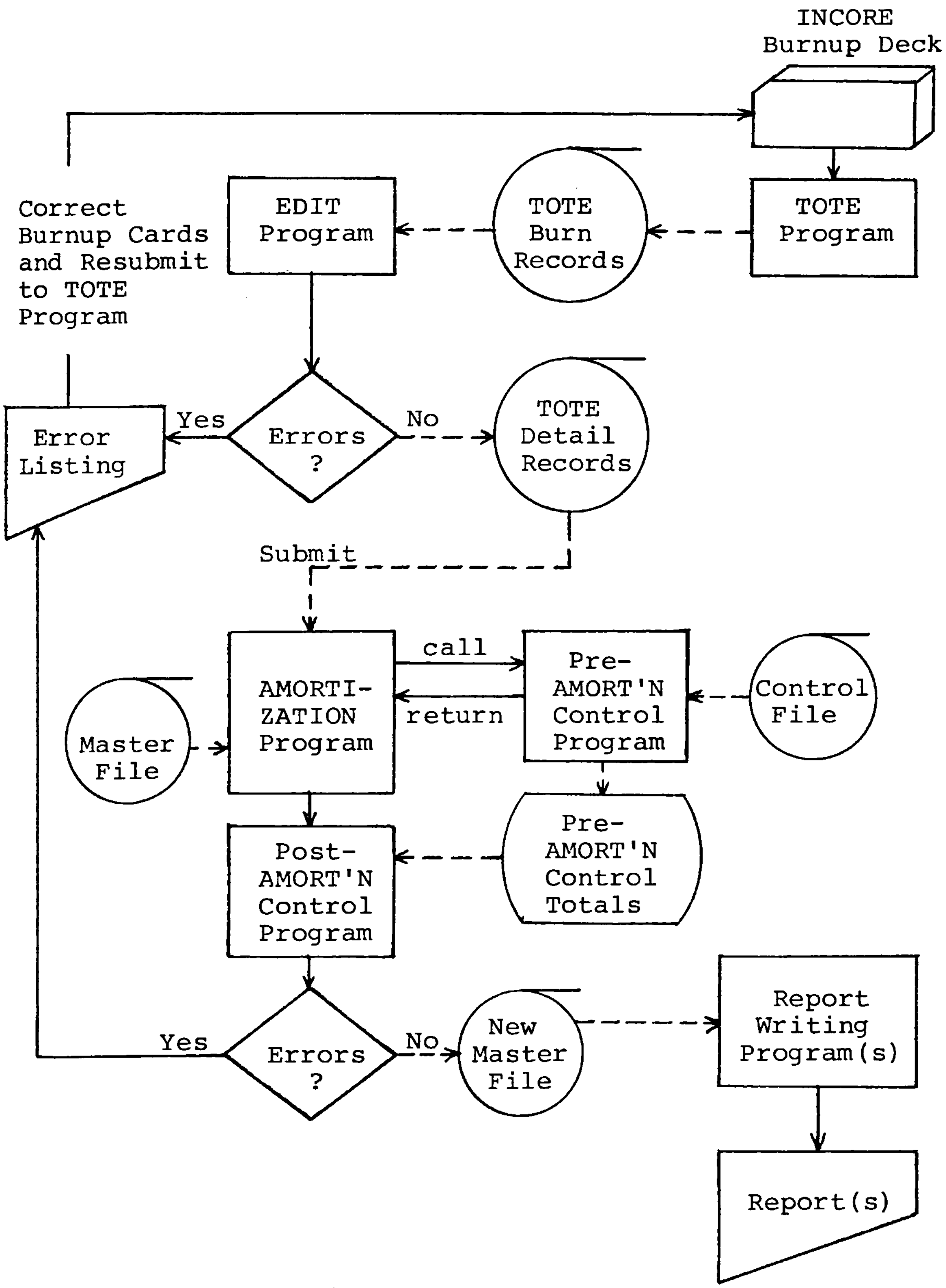

Fig. 7. VEPCO NFA System - Processing Flow Chart for Monthly Fuel Burnup and Amortization Calculations

NUCLEAR FUEL MATERIALS ACCOUNTABILITY

Another function of nuclear fuel management which is complementary with nuclear fuel accounting is nuclear fuel materials accountability. As a result, I was also assigned the task of developing an accountability system. Both the Nuclear Regulatory Commission (NRC) and the Department of Energy (DOE) have strict reporting requirements for special nuclear materials. Special nuclear materials (SNM) are defined as "plutonium, uranium 233, uranium enriched in the isotope 233 or the isotope 235, and any other material which the Commission . . . determines to be special nuclear material."[6] Accurate reporting of all such materials possessed by licensees is required to assist in detecting any unlawful diversion of SNM which could pose a threat to public safety. SNM routinely inventoried at a nuclear power plant are low-enriched uranium fabricated in the fuel elements, and plutonium which is produced in the fuel elements during the fission process within the reactor.

Reporting Requirements for Nuclear Materials

The reporting requirements for all licensees regarding nuclear materials are specified throughout Title 10 of the Code of Federal Regulations. The routine reports required of nuclear power plants are outlined briefly in

Table IV. The NRC and DOE maintain a joint data-base so that one report sent to DOE at Oak Ridge satisfies the requirements of both agencies.

Since enriched uranium and plutonium are produced from natural uranium, and U-233 is produced from thorium, natural uranium and thorium are considered source materials. Utilities, therefore, are required to annually submit a statement of Source Material Inventory, giving the location and amount of all source materials to which they have title. A copy of this statement from Texas Utilities Generating Company for 1977 is contained in Appendix C.

The Material Status Report is a report of all inventories of SNM in the possession of the utility, i.e., physically located at the plant site. The inventories of each isotope must be reported accurately and consistently to the nearest gram. This report must be filed semi-annually on Form NRC/ERDA-742. A copy of this form is contained in Appendix D.

The utility must report any receipt or shipment of SNM to both DOE and the shipper or receiver. During normal operations this would occur only when new fuel is received from the fabricator or when spent fuel is being shipped for reprocessing or disposal. The quantities of each isotope reported must also be accurate to the

TABLE IV

Routine Reporting Requirements for Source Material and Special Nuclear Material

Annual Statement of Source Material Inventory

Required By:	10 CFR Parts 40.64(b) and 150.17(b)
Report Deadline:	30 days after September 30 each year
Recipient:	U.S. DOE, Oak Ridge, Tennessee
Content:	Written statement itemizing all inventories of source material

Material Status Report

Required By:	10 CFR Part 70.53(a)
Report Deadline:	30 days after March 31 and September 30 each year
Recipient:	U.S. DOE, Oak Ridge, Tennessee
Content:	Form NRC/ERDA 742 - for SNM in excess of 350 g contained U-235, U-233 or plutonium inventoried at the end of the reporting period

Nuclear Material Transaction Report

Required By:	10 CFR Parts 40.64(a), 70.54, 150.16(a) and 150.17(a)
Report Deadline:	Shipper - at the time of shipment Receiver - within 10 days of receipt of material
Recipient:	Shipper - 1 copy to U.S. DOE, Oak Ridge, Tennessee; 3 copies to receiver Receiver - 1 copy to U.S. DOE, Oak Ridge, Tennessee; 1 copy to shipper
Content:	Form NRC/ERDA 741 - any transfer or receipt of SNM in excess of 1 g contained U-235, U-233 or plutonium

nearest gram. This report must be filed on Form NRC/ERDA-741. All transfers of material reported by the utility on Form 741 are also recorded on the Form 742 filed for that period. A copy of Form NRC/ERDA-741 is contained in Appendix E.

In addition to these reporting requirements, it is advantageous for the utility to maintain, for the purpose of responsible contract administration, a complete and accurate record of all nuclear fuel materials in process and held in inventory. Actual processing losses should also be recorded to ensure contract compliance. Since the utility does not normally receive a copy of Form 741 for materials shipped from one supplier or processor to another, the data requirements for such transactions may be met by inserting a clause in the contract for materials or services requiring such a copy.

Requirements for System Design

Since TUGCO was already accumulating source material in preparation for fuel processing to begin in 1978, it was essential that a materials accountability data base be available for recording all material acquisitions and transfers. Prior to the arrival of finished fuel assemblies at the plant site, scheduled for the summer of 1980, the only report required by the utility would be the annual Statement of Source Material Inventory. The immediate consideration in designing the accountability system, therefore, was to maintain an accurate record of all nuclear materials involved in the fuel fabrication processes. The basic requirements for such a system are listed in Table V.

TABLE V

Requirements for a Nuclear Fuel Materials Accountability System

1. The data base should be readily accessible for use in contract administration.
2. The system should facilitate the entry of data from Form 741 reports when they are available.
3. Since Form 741's are often revised upon the completion of final inspection and assaying, the system should facilitate the revision of previously entered data.
4. The information necessary for all routine reports to the NRC should be maintained in the data base.
5. The system should provide a report giving a complete breakdown of source material inventory as to quantity and location.
6. The system should provide other reports as needed to meet the NRC reporting requirements.
7. The system should include the necessary editing and file maintenance routines to ensure an error-free data base.

A report showing the chronological movement of materials through the different processes and the physical location and quantity of these various materials would provide the information needed for reporting the source material inventory. The data base should contain all the information required for the other routine reports as well. This would allow for easier data entry from the Form 741 reports as well as simplify the task of adding the other report-writing programs when necessary.

To be useful for contract administration the data base and report programs should be readily accessible to all of the engineers in the Nuclear Fuel Section. Interactive programs would enhance the accessibility of the system by providing self-prompting instructions. Implementing the programs on the section's minicomputer would provide the interactive capability as well as improve their physical accessibility since the company's main computer is located in another building three blocks away.

System Design

The decision to implement the system on the minicomputer meant that all software development would be done in-house to make the most efficient use of its program memory and magnetic diskette storage device. The minicomputer to be used was a Wang PCS-II with 8K (8192 bytes) of program memory, a 16 by 64 character CRT, a 112-column matrix printer and a single magnetic diskette drive. The diskette had a capacity of 87.5K (89,600 bytes) of storage space divided into 350 sectors of 256 bytes each.

The major design consideration was to achieve the most efficient storage of data base information compatible with the minicomputer's internal cataloging procedure for data storage and retrieval through the diskette drive. Judicious selection of the number and size of the data variables contained in each record resulted in the use of 255 bytes in each sector to store two complete data records. A schematic file layout for the data base is contained in Appendix F. Each record contains: the account number to which the transaction will be added; the account number from which the transaction will be subtracted; the date of the transaction; the last date any revisions to the record were made; the plant unit and fuel batch numbers associated with the transaction, if any; the material type code (MTC), the composition code (CC) and the reporting identification symbol (RIS) of the receiver from the Form 741 report; the quantity of U_3O_8, the number of fuel assemblies, and/or the isotopic composition of any contained uranium or plutonium, where appropriate; and a 21-character description of the transaction. Figure 8 is an example of the data base listing.

The four-digit account numbers are the keys to keeping track of the quantity and location of the various materials within the system. The number is of the form

TO.SS

where TO is the general account number assigned on the following basis

T, the tens digit, denotes material type

1 = U_3O_8

2 = Natural UF_6

3 = Enriched UF_6

4 = Fabricated Fuel Assemblies

O, the ones digit, denotes the type of account

0 = In Stock Account

5 = In Process Account

8 = Processing Losses and Tails

and SS is the subaccount number based on the location of the material, such that

10-19 = all conversion plants

20-29 = all enrichment plants

30-39 = all fuel fabricators

NUCLEAR FUEL INVENTORY FILE

TO ACCT.	FROM ACCT.	TRANS. DATE	REVISE DATE	UNIT	BATCH	MTC	CC	# OF ASSMB	RIS	DESCRIPTION OF DATA	lbs U308	kg U	kg U-235	kg Pu	kg Pu-239&241	kg Pu-240
20.20	99.99	060776	060776			81	100	000	QFA	UF6 - UNITED NUCLEAR	0.000	76544.000	0.000	0.000	0.000	0.000
10.10	99.99	091577	091577			81	032	000	YTD	U308 - UTILITY FUELS	157000.000	0.000	0.000	0.000	0.000	0.000
15.10	10.10	042578	042578			81	032	000	YTD	1ST CONVERSION BATCH	122079.000	0.000	0.000	0.000	0.000	0.000
20.10	15.10	052978	052978			81	100	000	YTD	CONVERTED UF6 PRODUCT	121468.000	46720.000	0.000	0.000	0.000	0.000
18.10	15.10	052978	052978			81	100	000	YTD	CONVERSION LOSSES	611.000	0.000	0.000	0.000	0.000	0.000
10.10	99.99	061078	061078			81	032	000	YTD	U308 - WESTINGHOUSE	133791.000	0.000	0.000	0.000	0.000	0.000
25.20	20.10	061578	061578			81	100	000	QFA	PART - 1ST ENR BATCH	0.000	46720.000	0.000	0.000	0.000	0.000
25.20	20.20	061578	061578			81	100	000	QFA	PART - 1ST ENR BATCH	0.000	42418.000	0.000	0.000	0.000	0.000
28.20	25.20	091578	091578			10	100	000	QFA	ENRICHMENT TAILS	0.000	57586.000	0.000	0.000	0.000	0.000
30.20	25.20	091678	091678	CP1	001	20	100	000	QFA	1.6 % ENRICHED UF6	0.000	29836.000	477.376	0.000	0.000	0.000
30.20	25.20	091678	091678	CP1	002	20	100	000	QFA	2.4 % ENRICHED UF6	0.000	1716.000	41.184	0.000	0.000	0.000
35.30	30.20	092578	092578	CP1	001	20	100	000	WES	FABRICATE 1.6% BATCH	0.000	29836.000	477.376	0.000	0.000	0.000

Fig. 8. Example Listing of the Nuclear Fuel Inventory Data Base

40-49 = all reactor new fuel storage areas

50-59 = all reactor cores

60-69 = all reactor spent fuel pools.

For example, Account 38.31 would be the account for recording all enriched UF_6 (3) process losses (8) during fabrication at a particular fabrication plant (31).

System Operation

The entry and revision of transactions within the system is accomplished through the file maintenance routines which can also initialize the file, as well as edit all new and revised records for errors. The processing flow chart for these routines is shown in Figure 9. Since this is an interactive program the decision blocks indicate decisions made by the user during execution. All entries to the data base must be made in chronological order or they will not be accepted. Upon the completion of all additions, deletions and revisions, the disk file containing the data base is read by an edit routine which checks for errors such as: invalid account numbers; invalid RIS, MTC or CC codes; invalid transaction or revision dates; invalid unit or batch designations; negative quantities; and isotopic compositions which are impossible. The incorrect record is listed along with a message identifying the error(s). The user can correct

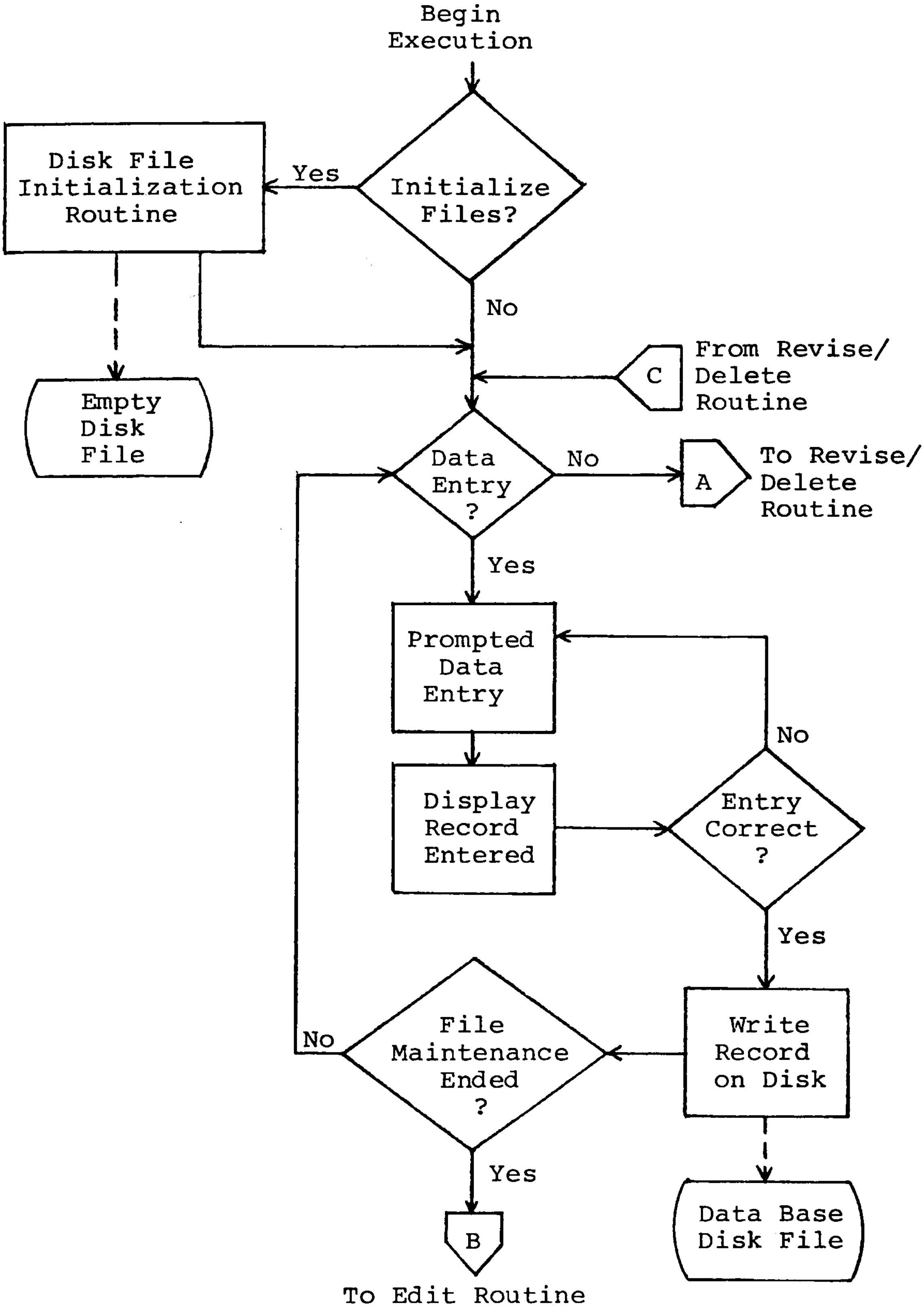

Fig. 9. Nuclear Fuel Inventory Data Base - Processing Flow Chart for Data Entry and File Maintenance

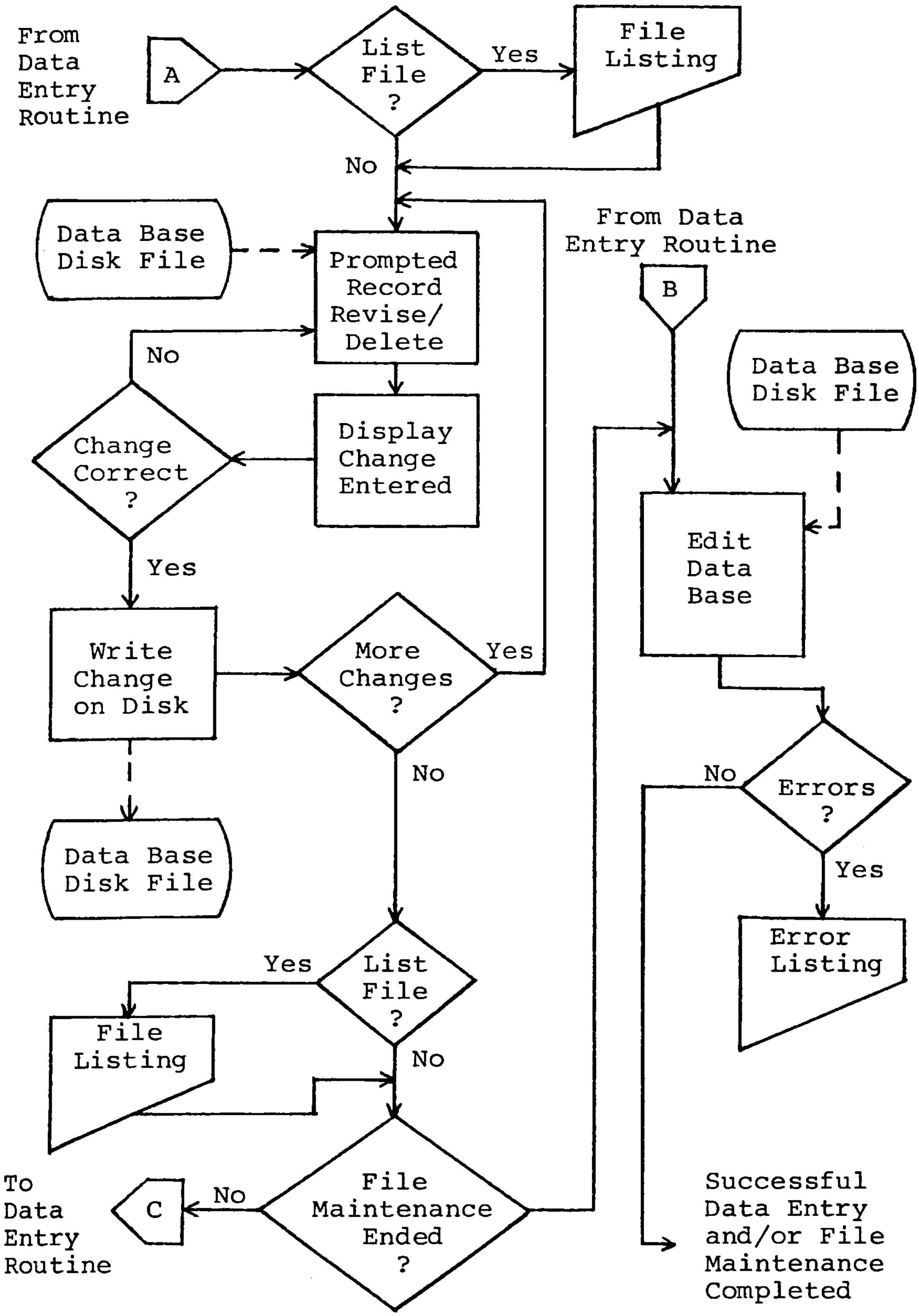

Fig. 9 - (continued)

these errors by calling up the file maintenance program again and making the necessary changes.

The report program will generate a report showing the activities within any In Stock, In Process or Processing Losses and Tails Account. The program lists, chronologically, all transactions to and from all subaccounts within a general account number specified by the user. The balance of all isotopic quantities pertinent to the account is shown after each transaction. A breakdown of the location of all materials in the final balance is given at the end of the report. Figure 10 is an example of such a listing.

In addition to the actual, historical data base, other disk files could be used to project future inventories based on present contractual commitments. This would greatly facilitate inventory management by accurately predicting major shortfalls or excesses. Proposed future transactions such as major purchases or sales could be readily evaluated for their impact on the fuel supply.

ACTIVITY REPORT ON

ACCOUNT # 30.XX
EnUF6 STOCK

DATE	FROM ACCT.	TO ACCT.	DESCRIPTION OF DATA	UNIT	BATCH	kg U in UF6	kg U-235
09/16/78	25.20	30.20	1.6 % ENRICHED UF6	CP1	001	29836.000	477.376
			BALANCE			29836.000	477.376
09/16/78	25.20	30.20	2.4 % ENRICHED UF6	CP1	002	1716.000	41.184
			BALANCE			31552.000	518.560
09/25/78	30.20	35.30	FABRICATE 1.6% BATCH	CP1	001	29836.000	477.376
			BALANCE			1716.000	41.184
07/25/78	30.20	35.30	FABRICATE 2.4% BATCH	CP1	002	1716.000	41.184
			BALANCE			0.000	0.000
04/15/79	25.20	30.30	2.4 % ENRICHED UF6	CP1	002	27661.000	663.864
			BALANCE			27661.000	663.864
04/15/79	25.20	30.30	3.1 % ENRICHED UF6	CP1	003	29377.000	910.687
			BALANCE			57038.000	1574.551
04/15/79	25.20	30.30	3.2 % ENRICHED UF6	CP1	004	1627.000	52.064
			BALANCE			58665.000	1626.615
04/30/79	30.30	35.30	FABRICATE 2.4% BATCH	CP1	002	27661.000	663.864
			BALANCE			31004.000	962.751
04/30/79	30.30	35.30	FABRICATE 3.1% BATCH	CP1	003	29377.000	910.687
			BALANCE			1627.000	52.064

LOCATION OF INVENTORY

		kg U in UF6	kg U-235
QFA	DOE O.R.TN	0.000	0.000
WES	W'HOUSE SC	1627.000	52.064

Fig. 10. Nuclear Fuel Inventory Data Base - Example Activity Report on Enriched UF_6 in Stock

OTHER PROJECTS

In addition to the two major undertakings mentioned above, I was involved in several other projects throughout the internship period. One of these was a complete financial analysis of a proposed uranium joint-venture in South Texas. The actual analyses are proprietary, but the results indicated that the proposed terms were not acceptable to the Company. After an unsuccessful attempt to negotiate more favorable terms, the project was dropped. Some of the other projects to which I was assigned are discussed below.

Economic Analysis of the Nuclear Fuel Cycle

One important function of the Nuclear Fuel Section is the performance of various economic analyses of the nuclear fuel cycle for the Comanche Peak Station as well as any possible future plants. These provide the information which is requested by several different departments within the Company. Detailed cash flow estimates are required by upper management for planning and capital budgeting purposes. The Systems Planning Section, which is responsible for the long-term planning of generation capacity, requires estimates of the annual nuclear fuel cost for comparison with the estimated future costs of alternative fuels. The plant operating personnel need to know what effect scheduled and unscheduled outages will have on the nuclear fuel cost in order to develop their operating strategies.

At TUSI these analyses are performed with the aid of a computer code developed by General Atomic called GACOST. Given input data such as fuel processing lead times, fuel enrichment, costs for all fuel cycle materials and services, expected burnup, projected plant capacity factors, the fuel reloading schedule, the cost of capital, the expected rate of inflation and other relevant parameters, the code will calculate the annual fuel cycle cost, a levelized fuel cycle cost, the estimated monthly cash flows and related information for periods of up to 30 years. The nuclear fuels engineer is responsible for gathering and preparing reliable input data based on the various cases under study.

In March the plant operations staff requested some information regarding the impact of various refueling schedules and plant capacity factors upon nuclear fuel cycle costs. Figure 11 is a copy of the memorandum presenting the results of a series of case studies which I made using the GACOST code.

TEXAS UTILITIES SERVICES INC.

OFFICE MEMORANDUM

To J. C. Kuykendall — Dallas, Texas March 24, 1977

Subject The Effect on Fuel Cycle Costs of Different Operating Strategies for Comanche Peak Unit 1

In response to Dwight Braswell's questions concerning the costs of different operating strategies for Comanche Peak Unit 1, we would like to present the following information.

% Change From Base Case Fuel Cycle Cost

Reload Interval	Case 1 Decreased Energy Utilization	Case 2 1st Cycle Extended	Case 3 1st, 2nd & 3rd Cycles Extended	Case 4 All Cycle Lengths Decreased
1	+24.9	+7.2	+ 8.2	-3.8
2	+28.4	+3.7	+13.6	-3.5
3	+25.4	+2.4	+14.0	-4.5
4	+17.7	+2.0	+ 7.0	-6.5
5	+17.7	+0.5	+ 5.8	-8.3

The Base Case represents the estimate of operating levels and respective costs currently used for scheduling and budgeting purposes. In Case 1, the plant is assumed to be operated with a reduced capacity factor but refueling occurs on the same schedule as the Base Case. The result is a 15% decrease in energy extracted from the fuel, i.e. fuel is discharged without utilizing all the available energy. Cases 2, 3 and 4 all represent the same energy utilization as the Base Case, but over different lengths of time. Cases 2 and 3 represent the effect of lengthening the cycles and Case 4 approximates the most optimistic energy consumption rate. The capacity factors and cycle lengths for these cases are given below.

Reload	Base Case		Case 1		Case 2		Case 3		Case 4	
Interval	CF	Length	CF	Length	CF	Length	CF	Length	CF	Length
1	.70	1.25 yr	.61	1.25 yr	.51	1.75 yr	.51	1.75 yr	.90	1 yr
2	.75	1 yr	.64	1 yr	.75	1 yr	.49	1.5 yr	.90	10 mo
3	.75	1 yr	.64	1 yr	.75	1 yr	.52	1.5 yr	.93	10 mo
4	.80	1 yr	.67	1 yr	.80	1 yr	.80	1 yr	.95	10 mo
5	.80	1 yr	.67	1 yr	.80	1 yr	.80	1 yr	.95	10 mo

The major point that can be deduced is the importance of utilizing the contained energy in the fuel. The residence time of the fuel in the core has little effect on the cost compared to the large penalty resulting from reduced energy utilization. In those cases where the fuel is fully utilized, there is much operating flexibility in determining the exact length of the cycles (to meet system requirements) with little effect on fuel costs.

RDC

Richard D. Calder

RDC:RLJ:ld
cc: H. C. Schmidt
C. W. Garrard

Fig. 11. Memorandum Explaining the Impact of Refueling Schedules and Capacity Factors on Fuel Cycle Costs

Levelized Fixed Charge Rate for Nuclear Fuel

The levelized fixed charge rate (LFCR) is an indicator of the annual cost of a capital investment to the company. Multiplying the LFCR times the initial cost will yield the annual cost necessary to carry and repay an investment obligation. This annual cost has four components: the cost of capital; the annuity depreciation cost; federal income taxes; and property taxes and insurance. Although nuclear fuel is a capital investment, it has a much shorter lifetime than does the generating plant. It was realized by upper management that nuclear fuel would therefore have a significantly different LFCR than that used for a generating plant. I was asked to determine what the LFCR should be. Appendix G contains all the calculations made in determining the LFCR.

The cost of capital is calculated from the cost, to the company, of the various sources of capital available, taking into account the capital structure of the firm. The cost of capital was found to be 12.10%. The annuity depreciation cost is the levelized cost of straight-line depreciation based on a discount rate equal to the cost of capital. This is also referred to as the sinking fund factor. The estimated useful lifetime for nuclear fuel, as specified by the Internal Revenue Service for tax purposes, is four to six years. Since, under normal operations, the fuel is expected to be in the reactor for three years, the minimum lifetime was used. For four years, the straight-line depreciation is 25% and the annuity depreciation, based on the cost of capital, is 20.89%. The levelized federal income tax contribution is calculated based on an accelerated (sum-of-the-years'-digits) depreciation method. The interest expense on bonds is also deducted before taxes. The tax contribution was found to be 3.28%. Property taxes and insurance generally add 1% to the LFCR. The final result was a LFCR of 37.27% for nuclear fuel based on a four year useful lifetime.

Nuclear Fuel Status Report

Since over 99% of the revenues for the Texas Utilities Company System are generated by the three electric utilities, it is vital that their management be informed of the specific nature of the rather large expenditures for nuclear fuel which their companies are helping to finance. At the end of 1977 I prepared a Nuclear Fuel Status Report to be sent to the upper management of all the companies within the System. The purpose was to inform them of the nuclear fuel supply situation for the Comanche Peak Station and to outline all fuel expenditures anticipated through 1978. A copy of this report is contained in Appendix H.

Westinghouse Litigation

TUSI had contracted with the reactor vendor, Westinghouse Electric Corporation, to purchase slightly less than 3,000,000 lbs. of uranium concentrates for use in the initial core and first reload batch for each unit of the Comanche Peak Station. In September 1975 Westinghouse canceled this contract along with similar contracts it had with 24 other utilities, totaling in excess of 65,000,000 lbs., on the basis that it would be commercially impracticable to fulfill them due to the unpredicted, dramatic increase in the market price of uranium:

> Westinghouse had contracted to supply the uranium at an average of $9.50 a pound, but the price of uranium has climbed to more than $40 a pound. Fulfilling the contracts at current prices could cost Westinghouse "in excess of $2.5 billion," over the next 18 years.[7]

TUSI, along with the other 24 utility companies, filed suit against Westinghouse for breach of contract. The TUSI suit was consolidated with 9 other utility lawsuits in a Federal Court in Richmond, Virginia. At the time of the suits, a court-ordered allocation of Westinghouse's available uranium supply awarded 470,000 lbs. to TUSI to be paid for at the contract price.

In an attempt to settle out-of-court, Westinghouse would, from time to time, offer various proposals regarding delayed payments for the concentrates to be delivered, other goods and services, interests in uranium properties or joint ventures, and other similar compensations. It was the responsibility of the Nuclear Fuel Section to evaluate these proposals and put a "price-tag" on them if possible. This involved engineering analyses and evaluations of equipment and design modifications offered, as well as economic analyses of the deferred payment schedules and other financial proposals. A final settlement was reached on December 27, 1977. The terms of the settlement are outlined briefly in an article from The Wall Street Journal contained in Appendix I.

SUMMARY AND OBSERVATIONS

I feel that, with regard to the objectives for the internship mentioned in the Introduction, my internship experience was most successful. This was due, in part, to Texas Utilities' involvement with and support of the Doctor of Engineering program over the past few years. Dr. Bill Garrard, Executive Vice President of Basic Resources Inc., is a member of the Industrial Representatives Committee for the Doctor of Engineering program. He was the Manager of Nuclear Fuel for TUSI when I applied for the internship position, and he was instrumental in arranging such an interesting internship experience. This type of involvement is certainly an advantage for the intern. My comments to Dr. Garrard on the internship are contained in a letter in Appendix J.

Nuclear fuel management is an area of engineering which is especially suited to utilizing many of the qualifications of a Doctor of Engineering intern within a very short period of time. Almost all of the engineering problems encountered are heavily influenced or constrained by economic considerations. I felt that the background provided by the program enabled me to fit right in to the organization and be productive almost immediately. Working in the Nuclear Fuel Section allowed me to not only practice good engineering, but to see the impact of engineering decisions on the rest of the company.

My professional development was enhanced in several areas. I was given many opportunities to improve my communication skills in both the written and spoken word. I was able to make many decisions regarding my projects and I learned a great deal about evaluating alternatives from my mistakes as well as my successes. Working with accountants, systems analysts and engineers from other companies as well as my own enabled me to improve my skills in interacting with other people, especially those in disciplines other than engineering. I was also able to attend a 3-day Project Management Seminar, conducted by a management consultant for all of TUSI's professional staff, which reinforced much of what I learned from the Doctor of Engineering curriculum.

In general, my internship was a most challenging and rewarding experience. The excellent background provided by the curriculum and the interest and cooperation of Texas Utilities contributed greatly to the overall success of the internship, and I have most certainly benefited from my participation in the program.

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4. Code of Federal Regulations, Title 18, Chapter 1-C, Part 101 - "Uniform System of Accounts for Public Utilities and Licensees (Class A and B)," (Revised 1965).

5. W. W. Lindsay, "Regulatory Issues in Nuclear Fuel Accounting and Ratemaking," presented to the American Nuclear Society Annual Summer Meeting (June 1977).

6. Code of Federal Regulations, Title 10, Chapter 1, Part 70.4(m).

7. "Westinghouse Agrees to Settle Dispute With 3 Utilities Over Uranium Contracts," The Wall Street Journal (March 4, 1977).

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"Engineering Economy Studies," Texas Electric Service Company (unpublished).

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W. R. Stimart, "Nuclear Fuel Accounting Practice at Duke Power Company," presented to the American Nuclear Society Annual Summer Meeting (June 1977).

"Texas Utilities Company 1976 Annual Report," Texas Utilities Company (March 24, 1977).

APPENDIX A

Objectives for Doctor of Engineering Internship with Texas Utilities Services Inc.

Source: Internship Progress Report to Dr. John D. Randall, letter dated February 1, 1977.

1. Make an identifiable engineering contribution to TUSI

2. Supplement my education in areas not covered in depth by formal coursework. Specifically -

    a) Nuclear Fuel Management
    b) Economics Problems Unique to Investor Owned Utilities

3. Improve my ability to communicate effectively

4. Develop skills in Engineering Management, such as -

    a) Being able to adapt to a new organizational structure and to function effectively within it
    b) Evaluating sources of information as to reliability and prejudice
    c) Working efficiently on several projects simultaneously
    d) Finding the best solution to a problem within the time and/or money available - i.e. a good engineering solution

5. Develop skills in working with people - especially those with different educational backgrounds or experiences.

APPENDIX B

FPC Uniform System of Accounts

Source: D. E. Howe and R. E. Barnette, "Nuclear Fuel Accounting," presented at the AGA-EEI Accounting Conference, Boston, April 1975.

Account 120.1 - Nuclear Fuel in Process of Refinement, Conversion, Enrichment and Fabrication

A. This account includes the original cost of nuclear fuel materials during the manufacturing process. It also includes the salvage value of recovered special nuclear materials which are being refabricated following the cooling period and reprocessing for subsequent use.

B. This account is credited when completed fuel assemblies are delivered for use in refueling, held as spares, or for use in initial core loading.

The costs that shall be included are:

1. The original cost of source materials
2. The original cost of special nuclear material
3. The salvage value of recovered special nuclear material in process of fabrication
4. The cost of milling
5. The cost of all sampling, weighing, assaying and inspections
6. The cost of purification and conversion
7. The cost of enrichment by gaseous diffusion or other methods
8. The cost of fabrication into fuel assemblies suitable for insertion in the reactor
9. Interest (AFUDC), insurance and taxes during fuel processing
10. The cost of shipping, handling and storage
11. Use charges on leased source and special nuclear materials while in process of refinement, conversion, enrichment and fabrication
12. Use charges on leased shipping containers for shipping source and special nuclear materials and fabricated assemblies while in process
13. Other overheads and contingencies
14. Quality assurance costs.

Account 120.2 - Nuclear Fuel Materials and Assemblies - Stock Account

A. This account shall contain the original total cost of fabricated fuel assemblies delivered for use in refueling or to be carried in stock as spares. This account shall also include the original cost of partially irradiated fuel assemblies that are being held in stock for reinsertion in a reactor. Also included in this account is the cost of unloading from shipping vehicles and inspecting all fabricated fuel assemblies.

B. This account shall include the original cost of source materials, special nuclear materials and fabrication materials being held for future use and not actually in process. Similarly, this account shall also include the salvage values of recovered special nuclear materials and by-product materials being held for future use.

Account 120.3 - Nuclear Fuel Assemblies in Reactor

This account shall include the original cost of nuclear fuel assemblies when inserted into a reactor for the production of electricity.

Account 120.4 - Spent Nuclear Fuel

This account shall include the original cost of nuclear fuel assemblies that have been removed from the reactor and that are in the process of cooling pending reprocessing.

Account 120.5 - Accumulated Provision for Amortization of Nuclear Fuel Assemblies

A. This account shall contain the amortization of the net cost of nuclear fuel assemblies used in the production of energy. The net cost of nuclear fuel assemblies subject to amortization shall be the original cost, including inspection and carrying charges, or nuclear fuel assemblies, minus (or plus) the expected net salvage value of the recovered special materials and by-product materials. Net salvage value is the value of recovered nuclear materials and by-product materials, less the cost of all shipping, handling, assaying, reprocessing and carrying charges accrued since the spent fuel was removed from a reactor. The cost of shipping shall include any lease charges on spent fuel shipping containers leased for shipment of the spent fuel to the reprocessing facility.

B. This account shall include the net salvage value of recovered special nuclear materials and by-product materials when such materials are sold, transferred or otherwise disposed of.

Account 157 - Nuclear Materials Held for Sale

This account shall include the net salvage value of recovered special nuclear materials, by-product materials and source materials held for sale or other disposition that are not to be reused by the company in its electric utility operations.

Account 518 - Nuclear Fuel Expense

A. This account shall contain charges for the amortization of the net cost of nuclear fuel assemblies used in the production of energy. The utility will adopt the necessary procedures to assure that charges to this account are distributed according to the thermal energy produced by this fuel.

B. This account shall also include the costs involved when fuel is leased. It will also include the cost of other fuels used for auxiliary steam facilities, including superheat.

C. This account shall contain appropriate entries for significant changes in the amounts estimated as the net salvage value of special nuclear materials and by-product materials and the amount actually realized upon the final disposition of these materials.

D. When there is a significant decline in the estimated net salvage value of special nuclear materials and by-product materials in the reactor, the effect of this decline on the net cost of this fuel shall be amortized over the remaining life of this fuel while still in a reactor producing power.

APPENDIX C

Statement of Source Material Inventory

TEXAS UTILITIES GENERATING COMPANY
2001 BRYAN TOWER · DALLAS, TEXAS 75201

September 30, 1977

U.S. Energy Research and
Development Administration
P. O. Box E
Oak Ridge, TN 37830

Dear Sir:

As required by 10CFR40.64, Texas Utilities Generating Company submits the following Statement of Material Inventory.

Name and Address: Texas Utilities Generating Company
2001 Bryan Tower
Dallas, Texas 75201

Reporting Identification Symbol (RIS): YGL
Report for Year Ending: September 30, 1977

Material Type	Physical Location	Quantity
UF_6	Held at an ERDA Enrichment Facility under ERDA Usage Agreement #E-(40-1)-5209	76,544 kg U in UF_6
U_3O_8 Concentrates	Held at the Kerr-McGee Sequoyah Facility near Gore, Oklahoma	157,623 lbs U_3O_8

If you have any questions concerning this statement, please call me at (214) 653-4789.

Sincerely,

Richard D. Calder
Nuclear Fuel Supervisor

RDC:ld

APPENDIX D

Form NRC/ERDA-742

FORM NRC/ERDA-742
(6-76)
10 CFR 70/ERDAM 7401
(Previous editions are obsolete)

U.S. NUCLEAR REGULATORY COMMISSION
AND
U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

APPROVED BY GAO
B-180225 (R0041)
EXPIRES 12-31-78

MATERIAL STATUS REPORT

1. NAME AND ADDRESS	2. LICENSE NUMBER(S)		3. REPORTING IDENTIFICATION SYMBOL (RIS)
	4. REPORT PERIOD		5. MATERIAL TYPE *(Submit separate report for each type)*
	FROM	TO	

MATERIAL ACCOUNTABILITY		
6. QUANTITY BY ELEMENT AND ISOTOPE WEIGHT	A. ELEMENT WEIGHT	B. ISOTOPE WEIGHT
8. BEGINNING INVENTORY – ERDA OWNED		
9. BEGINNING INVENTORY – NOT ERDA OWNED		
RECEIPTS		
11. PROCUREMENT FROM ERDA *RIS* FROM:		
13. PROCUREMENT – OTHER		
14. DOD RETURNS – USE A		
15. DOD RETURNS – USE B		
16. DOD RETURNS – OTHER USES		
21. PRODUCTION		
22. FROM OTHER MATERIALS		
30. RECEIPTS REPORTED TO NRC/ERDA ON FORM NRC/ERDA-741 *(Not listed elsewhere)* FROM: *RIS*		
40. TOTAL		
REMOVALS		
41. EXPENDED IN SPACE PROGRAMS		
42. SALES TO ERDA *RIS* TO:		
43. SALES TO OTHERS FOR THE ACCOUNT OF ERDA *RIS* TO:		
44. DOD – USE A		
45. DOD – USE B		
46. DOD – OTHER USES		
47. EXPENDED IN ERDA TESTS		
48. ROUTINE TESTS		
49. SHIPPER-RECEIVER DIFFERENCE		
51. SHIPMENTS REPORTED TO NRC/ERDA ON FORM NRC/ERDA-741 *(Not listed elsewhere) RIS* TO:		
71. DEGRADATION TO OTHER MATERIALS		
72. DECAY		
73. FISSION AND TRANSMUTATION		
74. NORMAL OPERATIONAL LOSSES/MEASURED DISCARDS		
75. ACCIDENTAL LOSSES		
76. APPROVED WRITE OFFS		
77. MATERIAL UNACCOUNTED FOR		
80. ENDING INVENTORY – ERDA OWNED		
81. ENDING INVENTORY – NOT ERDA OWNED		
82. TOTAL		

(See Reverse Side)

P
(1)

COMPOSITION OF ENDING INVENTORY

1. COEI AS OF: ______ (2-6)
(Date)

2. REPORTING IDENTIFICATION SYMBOL ______ (7-9)

NON-ERDA OWNED INVENTORY

3.A. MATERIAL TYPE ______ (10-11)

3.B. ENRICHMENT LEVEL: ______ (10-11)
(For U-235)

4. INVENTORY COMPOSITION CODE (12-14)	DESCRIPTION	ELEMENT WEIGHT (15-27)	ISOTOPE WEIGHT (28-40)
860	IN REACTORS AND CRITICAL ASSEMBLIES		
861	IN COOLING		
862	IN CONVERSION AND FABRICATION PROCESSES		
863	IN RECOVERY PROCESSES		
864	MATERIAL NOT IN PROCESS		
865	UNIRRADIATED SCRAP AWAITING RECOVERY		
866	UNIRRADIATED SCRAP AWAITING DISPOSAL		
899	TOTAL *(Total must agree with quantity on line 81, "Ending Inventory – Not ERDA Owned," on front side of Form 742; for U-235, sum of separate total quantities by enrichment level must agree with line 81.)*		

5. **ERDA OWNED INVENTORY**
(Refer to ERDA Manual Appendix 7401C for reporting instructions)

MATERIAL TYPE CODE (10-11)	INVENTORY COMPOSITION CODE (12-14)	ELEMENT WEIGHT (15-27)	ISOTOPE WEIGHT (28-40)	ERDA PROJECT NUMBER (44-53)	SCRAP PROG. (54)	UESA CATEGORY CODE (56-58)	WEIGHT % ISOTOPE OR PARTS PER MILLION (59-64)	UESA PRODUCTION CODE (66)
	899 TOTAL			*(Total must agree with quantity entered on line 80, "Ending Inventory – ERDA Owned," on front side of Form 742.)*				

To the best of my knowledge and belief the information given above, and in any attached schedules, is true, complete and correct.

DATE	SIGNATURE	TITLE

18 U.S.C. SECTION 1001; ACT OF JUNE 25, 1948; 62 STAT. 749; MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

FORM NRC/ERDA 742 (6 76)

APPENDIX E

Form NRC/ERDA 741 (4-76)
ERDAM 7401/10 CFR 30, 40, 70, 150

Previous editions are obsolete.

U.S. NUCLEAR REGULATORY COMMISSION AND U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

Approved by GAO B-180225 (R0040) Expires 12-31-78

NUCLEAR MATERIAL TRANSACTION REPORT

DOCUMENTATION (Only if document is classified SECRET)
PAGE ___ OF ___ PAGES ___ COPY ___ OF ___ COPIES, SERIES ___

1. 1-4
2. TRANSFER CODE (2) (3) (4)
3. TRANSFER SERIES: RIS FROM (5-7) | RIS TO (9-11) | NO (13-18) | (19)
4. NUMBER OF LINES (1(20-21))
5. NATURE OF TRANSACTION (1(22))

6. NAME AND ADDRESS OF SHIPPER — LIC. NO.
ATTENTION:
TELEPHONE:

7. NAME AND ADDRESS OF RECEIVER — LIC. NO.
ATTENTION:
TELEPHONE:

8. SHIPPED FOR ACCOUNT OF — RIS (1(23-25))
9. SHIPPED TO ACCOUNT OF — RIS (1(26-28))

10. IMPORT OR EXPORT TRANSFERS
LICENSE NO. (3(22-31)) | U.S. PORT ENTRY/EXIT (3(32-35))

NO.	DISTRIBUTION OF COPIES
1	
2	
3	
4	
5	
6	
7	
8	
9	

11. TRANSPORTATION PROFILE			12. PACKAGE IDENTIFICATION	
TRIP SEG.	CARRIER IDENTIFICATION	TRANSFER POINT	MODEL ID	NO.
1	(3(36-39))	(3(40-44))	(4(22-25))	(4(26-28))
2	(3(45-48))	(3(49-53))	(4(29-32))	(4(33-35))
3	(3(54-57))	(3(58-62))	(4(36-39))	(4(40-42))
4	(3(63-66))	(3(67-71))	(4(43-46))	(4(47-49))
5	(3(72-75))		(4(50-53))	(4(54-56))

13. TRANSFER AUTHORITY—CONTRACT, NM DRAFT, OR ORDER NUMBER (1(34-50))

14. MATERIAL TYPE AND DESCRIPTION

15. MISCELLANEOUS

16. SHIPPER'S DATA

A. DATE SHIPPED OR CORRECTION ENTERED: MO (1(70-71)) DAY (1(72-73)) YR (1(74))

B. SIGNATURE OF AUTHORIZED OFFICIAL AND DATE SIGNED

LINE NO. (2(20-21)) C	ERDA PROJECT NUMBER AND IDENTIFICATION (2(22-31)) D	MATERIAL TYPE (2(32-33)) E	COMPOSITION CODE (2(34-36)) F	OWNER CODE (2(37)) G	USE CODE (2(38-39)) H	NUMBER OF ITEMS (2(40-43)) I	GROSS WEIGHT J	NET WEIGHT K	ELEMENT WEIGHT (2(44-54)) L	WEIGHT % ISOTOPE (2(55-60)) M	ISOTOPE WEIGHT (2(61-69)) N	LIMITS OF ERROR: ELEMENT (2(70-74)) O	LIMITS OF ERROR: ISOTOPE (2(75-79)) P

16. Q. TOTAL GROSS WEIGHT (4(57-66))

16. R. TOTAL VOLUME (4(67-76)) (*Burial transfers only*)

17. RECEIVER'S DATA

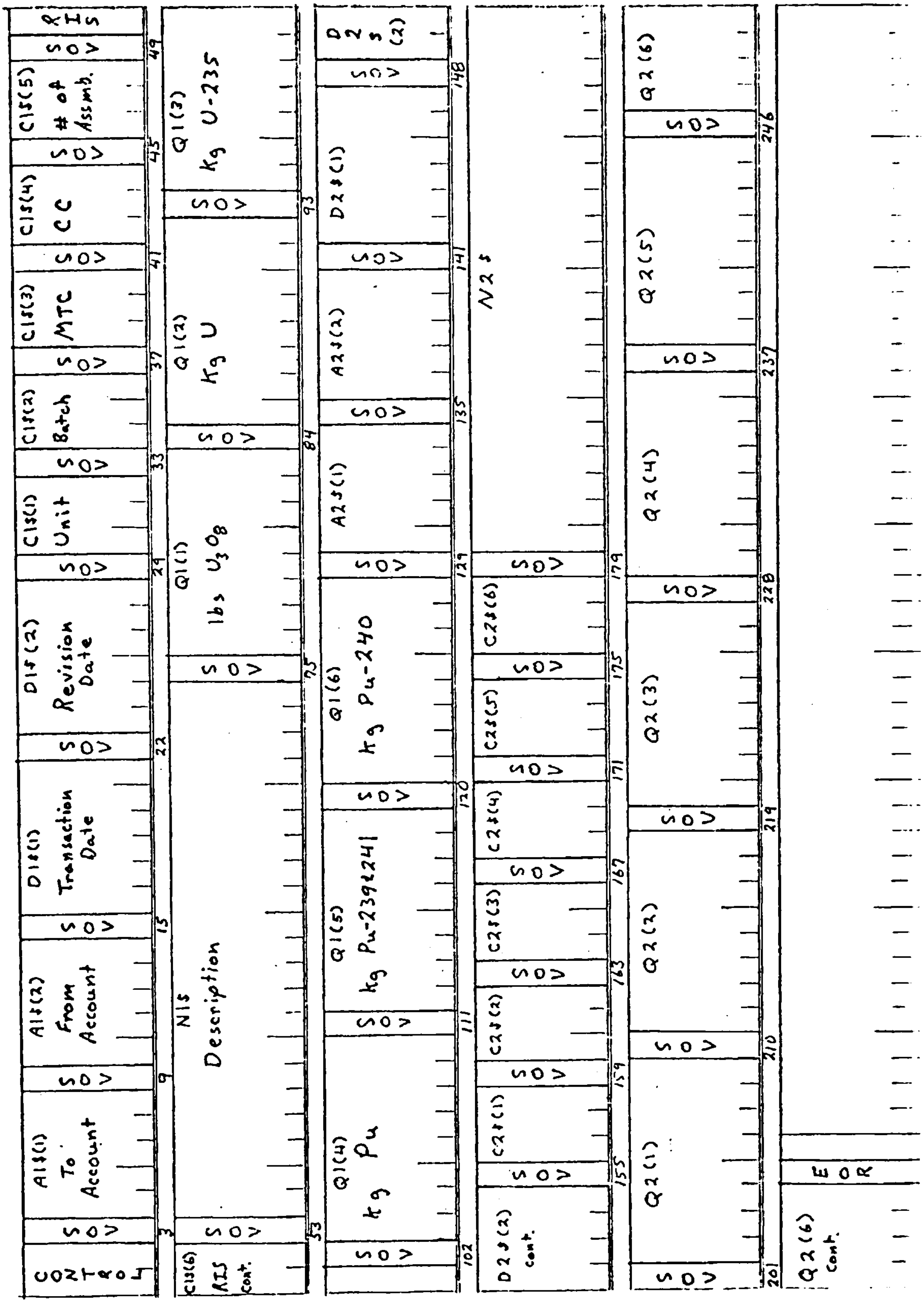
A. DATE RECEIVED OR CORRECTION ENTERED. MO (1(70-71)) DAY (1(72-73)) YR (1(74))

B. SIGNATURE OF AUTHORIZED OFFICIAL AND DATE SIGNED

LINE NO (2(20-21)) C	ERDA PROJECT NUMBER AND IDENTIFICATION (2(22-31)) D	MATERIAL TYPE (2(32-33)) E	COMPOSITION CODE (2(34-36)) F	OWNER CODE (2(37)) G	USE CODE (2(38-39)) H	NUMBER OF ITEMS (2(40-43)) I	GROSS WEIGHT J	NET WEIGHT K	ELEMENT WEIGHT (2(44-54)) L	WEIGHT % ISOTOPE (2(55-60)) M	ISOTOPE WEIGHT (2(61-69)) N	LIMITS OF ERROR: ELEMENT (2(70-74)) O	LIMITS OF ERROR: ISOTOPE (2(75-79)) P

APPENDIX F

Schematic Layout of Nuclear Fuel Inventory File



APPENDIX G

Calculation of the Levelized Fixed Charge Rate for Nuclear Fuel

Reference: "Engineering Economy Studies," Texas Electric Service Company (unpublished), pp. 11-29.

LFCR = Cost of Capital + Annuity Depreciation + Federal Income Taxes + Property Taxes and Insurance

Cost of Capital

Type of Capital	Proportion	Cost	Weighted Cost
Bonds	50%	10%	5.00%
Preferred Stock	15%	10%	1.50%
Common Stock	35%	16%	5.60%

Cost of Capital = 12.10%

Annuity Depreciation

$$ad = \frac{i}{(1 + i)^n - 1}$$

where

ad = Annuity Depreciation

i = cost of capital, .121

n = useful lifetime, 4 years

therefore

$$\text{Annuity Depreciation} = \frac{.121}{(1 + .121)^4 - 1} = \underline{20.89\%}$$

Federal Income Taxes

$$T = \left(\frac{t}{1 - t}\right)\left[(i + ad - sd) - t(dt - sd)\right]\left[1 - \frac{(B)(int)}{i}\right]$$

$$- t(dt - sd)$$

where

T = Federal Income Taxes

t = federal tax rate, .48

i = cost of capital, .121

ad = annuity depreciation, .2089

sd = straight-line depreciation, .25

dt = levelized sum-of-the-years'-digits depreciation (for taxes), .2642

B = fraction of bonds in capital structure, .50

int = interest rate on bonds, .10

therefore

Federal Income Taxes =

$$\left(\frac{.48}{1 - .48}\right)\left[(.121 + .2089 - .25) - .48(.2642 - .25)\right] \times$$

$$\left[1 - \frac{(.50)(.10)}{.121}\right] - .48(.2642 - .25) \quad = \quad \underline{3.28\%}$$

Property Taxes and Insurance estimated to be $= \underline{1.00\%}$

LFCR = 12.10% + 20.89% + 3.28% + 1.00% $= \underline{\underline{37.27\%}}$

APPENDIX H

Nuclear Fuel Status Report

Considerable progress was made in the nuclear fuel area over the past year. The procurement process is well underway and by the end of 1978 much of the services and materials for the first core of Comanche Peak Unit 1 will have been purchased.

In June 1976, 76,544 kg U in UF_6 form (equivalent to 200,000 lbs U_3O_8) was purchased from United Nuclear Corporation. Approximately 157,000 lbs U_3O_8 was purchased from Utility Fuels, Inc. in September 1977. These two purchases plus the expected fuel purchases for 1978 are listed in Table 1.

Table 1

URANIUM PURCHASES

Date	Quantity	Price	Supplier
June 1976	200,000 lbs U_3O_8 (in UF_6 form)		United Nuclear Corporation
September 1977	157,000 lbs U_3O_8	PROPRIETARY	Utility Fuels, Inc.
March 1978	500,000 lbs U_3O_8		Westinghouse Electric Corp.**
June 1978	133,791 lbs U_3O_8		Westinghouse Electric Corp.**
September 1978	300,000 lbs U_3O_8		United Nuclear Corporation
October 1978	336,209 lbs U_3O_8		Westinghouse Electric Corp.**

** As a result of the settlement of the Westinghouse litigation, the payment of PROPRIETARY for the U_3O_8 supplied by Westinghouse is not due until

The June 1976 purchase is inventoried in an ERDA Usage Contract. The purchase from Utility Fuels, Inc. is presently stored at the Kerr-McGee Sequoyah Conversion Facility. All 1978 uranium purchases will also be delivered to the

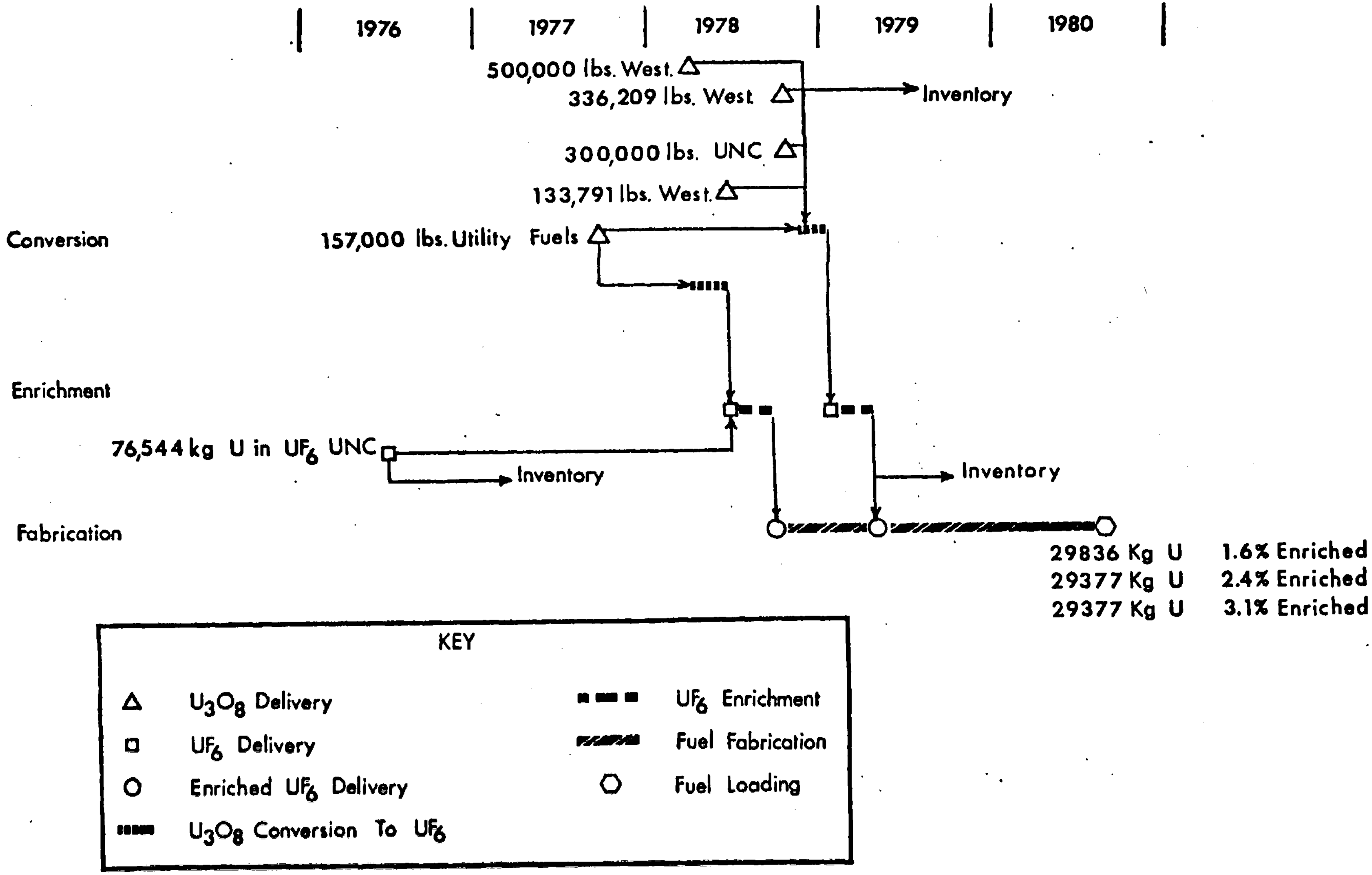
Sequoyah Facility. Figure 1 is a materials flow-chart which illustrates the processing of the uranium from these purchases.

Much of this U_3O_8 will be converted to uranium hexafluoride (UF_6) in 1978. 122,078 lbs U_3O_8 must be converted to UF_6 by June 1978 at an estimated cost of PROPRIETARY In June, this material will be shipped to a Department of Energy (DOE) Enrichment Plant for enrichment, along with 42,418 kg U in UF_6 (110,833 equivalent lbs U_3O_8) from the Usage Contract. This material will be enriched to 1.6% U-235 and 2.4% U-235 at an estimated cost of PROPRIETARY (PROPRIETARY of which has been paid in the form of annual pre-payments since 1973.) By September this enriched UF_6 will be ready for fabrication. A Fabrication Scrap Allowance PROPRIETARY must be paid to Westinghouse at the start of fabrication. This payment of PROPRIETARY will be refunded upon the completion of fabrication. By December 1978, 771,742 lbs U_3O_8 will have been converted, at an estimated cost of PROPRIETARY and delivered to DOE for enrichment.

Beginning in January 1979, the converted UF_6 will be enriched to 2.4% U-235, 3.1% U-235 and 3.2% U-235. This material will be ready for fabrication in April 1979. The 1.6%, 2.4%, and 3.1% enriched material will be fabricated for the August 1980 fuel loading date. The 3.2% enriched material will be held in inventory to be used in the first reload batch. Other inventories projected for the end of 1978 include 34,126 kg U in UF_6 (89,167 equivalent lbs U_3O_8) in the ERDA Usage Contract and 533,180 lbs U_3O_8 at the Kerr-McGee Sequoyah Facility. These inventories are a result of the fact that the terms of our take-or-pay contracts with DOE and Kerr-McGee are slightly in excess of our actual requirements.

Figure 1

CPSES 1 FIRST CORE SCHEDULE



In addition to the deliveries mentioned above, the administration of the fuel contracts includes giving advance notice to the different vendors regarding future services. Table 2 is a schedule of all required notices through December 1978. Note that the quantities of materials listed in Table 2 are the actual requirements for the first core of Unit 1 and they do not reflect the slight inventories which will be carried.

RLJ
1/4/78

DATE	UNIT	BATCH	EVENT	QUANTITY OF ORE (LBS U3O8)	QUANTITY OF UF6 (KG U IN UF6)	AMOUNT OF SEPARATIVE WORK (KG SWU)	QUANTITY OF ENRICHED PRODUCT (KG U IN UO2)
1-76	CP1		*NOTICE ERDA PROPOSED 2 YR SCHEDULE				
4-76			*CHANGE 10 PERCENT UF6 TO KERR MCGEE				
9-76	CP1		*NOTE W OPERATING CYCLE CORE 1 FSAR				
			TOTALS	0.	0.	0.	0.
1-77			*TENTATIVE SCHEDULE UF6 KERR MCGEE				
	CP1		*NOTICE ERDA PROPOSED 2 YR SCHEDULE				
3-77	CP1	1	*NOTICE W CHANGE ORE 5 PERCENT				
4-77			*CHANGE 10 PERCENT UF6 TO KERR MCGEE				
6-77	CP1		*NOTICE W CHANGE OF CONVERSION FAC				
	CP1	1	*NOTICE FIRM SCHEDULE UF6 KERR MCGEE				
7-77	CP1	2	*NOTICE W CHANGE ORE 5 PERCENT				
	CP1	3	*NOTICE W CHANGE ORE 5 PERCENT				
10-77	CP1	1	*NOTICE ERDA DELIVERY DATE ENRICH U				
			TOTALS	0.	0.	0.	0.
1-78	CP1	2	*NOTICE FIRM SCHEDULE UF6 KERR MCGEE				
	CP1	3	*NOTICE FIRM SCHEDULE UF6 KERR MCGEE				
			*TENTATIVE SCHEDULE UF6 KERR MCGEE				
	CP1		*NOTICE ERDA PROPOSED 2 YR SCHEDULE				
3-78	CP1	1	*NOTICE ERDA ABOUT U SPECIFICS				
4-78	CP1	1	ORE TO CONVERSION FACILITY	213614.			
	CP1	1	*KERR MCGEE DATE UF6 DELIVERED ERDA				

Table 2 (continued on next page)

DATE	UNIT	BATCH	EVENT	QUANTITY OF ORE (LBS U3O8)	QUANTITY OF UF6 (KG U IN UF6)	AMOUNT OF SEPARATIVE WORK (KG SWU)	QUANTITY OF ENRICHED PRODUCT (KG U IN UO2)
			*CHANGE 10 PERCENT UF6 TO KERR MCGEE				
5-78	CP1	3	*NOTICE ERDA DELIVERY DATE ENRICH U				
	CP1	1	*NOTICE ERDA TO OBSERVE WEIGHINGS				
	CP1	2	*NOTICE ERDA DELIVERY DATE ENRICH U				
6-78	CP1	1	UF6 TO ENRICHMENT FACILITY		82159.		
	CP1	1	*NOTICE ERDA TO OBSERVE WEIGHINGS				
	CP1	1	*NOTICE ERDA TO ACQUIRE TAILS				
8-78	CP1	1	*NOTICE WESTINGHOUSE ESTABLISH SUO				
	CP1	2	*NOTICE WESTINGHOUSE ESTABLISH SCO				
	CP1	3	*NOTICE WESTINGHOUSE ESTABLISH SCO				
9-78	CP1	2	ORE TO CONVERSION FACILITY	330460.			
	CP1	2	*KERR MCGEE DATE UF6 DELIVERED ERDA				
	CP1	1	START FABRICATION			42158.	
	CP1		*NOTICE ERDA OF SWU FOR 10 YRS HENCE				
10-78	CP1	2	*NOTICE ERDA TO OBSERVE WEIGHINGS				
	CP1	2	*NOTICE ERDA ABOUT U SPECIFICS				
	CP1	3	*NOTICE ERDA ABOUT U SPECIFICS				
	CP1	3	*KERR MCGEE DATE UF6 DELIVERED ERDA				
	CP1	3	ORE TO CONVERSION FACILITY	435624.			
11-78	CP1	3	*NOTICE ERDA TO OBSERVE WEIGHINGS				
	CP1	4	*NOTICE W CHANGE ORE 5 PERCENT				
	CP1	2	UF6 TO ENRICHMENT FACILITY		127100.		
12-78	CP1	3	UF6 TO ENRICHMENT FACILITY		167548.		
			TOTALS	979698.	376807.	42158.	0.

Table 2 (Cont'd)

APPENDIX I

Article on the Westinghouse Settlement

2 THE WALL STREET JOURNAL, Wednesday, Dec. 28, 1977

Westinghouse, 3 Utilities Settle Uranium Dispute

Firm to Provide Fuel, Cash, Property Rights, Services At Cost of $27 Million

By a WALL STREET JOURNAL *Staff Reporter*

RICHMOND, Va.—Westinghouse Electric Corp. said it settled its uranium-contract dispute with Texas Utilities Services Inc., or TUSI.

The final agreement, which will cost Westinghouse about $27 million, was reached with TUSI, acting as agent for Dallas Power & Light Co., Texas Electric Services Co. and Texas Power & Light Co.

The Texas utilities are three of 27 utilities that sued Westinghouse after the Pittsburgh-based company in September 1975 cancelled long-term contracts to supply those utilities with uranium fuel.

The settlement with TUSI represents 2,431,000 pounds of uranium. When adjusted for uranium to be delivered under an allocation plan previously ordered by a court, TUSI's claim represents about 3% of Westinghouse's 65 million-pound uranium shortage.

Eight Lawsuits Remain

Last week, Westinghouse and TUSI had reached a tentative agreement which was approved formally Monday by federal Judge Robert R. Merhige Jr. The out-of-court settlement leaves eight utility lawsuits against Westinghouse, which are consolidated in Richmond and currently are being tried before Judge Merhige.

Under the agreement, Westinghouse said it will provide cash, uranium, services and certain rights to uranium property to TUSI. The terms include:

—Westinghouse will pay $4 million cash to TUSI in 30 days.

—Westinghouse will provide certain equipment and services to TUSI without charge, 470,000 pounds of uranium under the court-ordered allocation plan at the contract price and 500,000 pounds of uranium at a "favorable price."

—Westinghouse will transfer uranium-property rights to TUSI from its uranium mining subsidiary, Wyoming Minerals Corp. In addition, TUSI will receive an option to certain benefits that Wyoming Mineral will get from a joint venture.

—Westinghouse will provide to TUSI a nonexclusive, royalty-free technical assistance and patent license agreement involving solution-mining technology for uranium.

Four Other Settlements

Westinghouse said the "total escalated cost" of the "current and future obligations" of the settlement will be about $27 million, which will be charged against earnings in the 1977 fourth quarter. The company added that the "net settlement cost," however, has a current value of $23.5 million.

Westinghouse already has settled out of court with Alabama Power Co., a unit of Southern Co., and with three utilities that sued it in Pennsylvania—Duquesne Light Co., Pennsylvania Power Co. and Ohio Edison Co.

Under the Pennsylvania settlement, the three utilities are entitled to additional compensation if other utilities settle with Westinghouse on more favorable terms. Westinghouse said the settlement with TUSI isn't expected to result in more compensation for those three utilities.

To date, settlements with utilities represent about 5% of Westinghouse's 65 million-pound uranium shortage.

APPENDIX J

Letter of Comment on the Doctor of Engineering Internship

TEXAS A&M UNIVERSITY
COLLEGE OF ENGINEERING
COLLEGE STATION TEXAS 77843

DEPARTMENT OF NUCLEAR ENGINEERING
713-845-4161

January 25, 1978

Dr. C. W. Garrard, Jr.
Basic Resources Inc.
2001 Bryan Tower
Dallas, Texas 75201

Dear Dr. Garrard:

In response to your request for my comments on my recently completed internship with TUSI, I have compiled the following list.

I have only two suggestions for improvement, both of which concern increased exposure of the intern to upper management.

1. It would have been much more beneficial if I had been able to meet more of the company executives early in my internship period. A great deal can be learned about the management philosophy of a company by talking with its executives. I feel that those I did meet provided me with some good advice and valuable insight into the operations of the company.

2. I would like to have attended more management meetings and perhaps staff meetings in some other areas of the company. I feel that observing the decision-making processes first-hand would have provided a better under- of how the company was run and how engineering decisions affected other segments of the company.

There were several experiences during my internship which were extremely beneficial and I feel they should definitely be included in any subsequent internships.

1. Within the first week Homer and Richard went over the organizational charts with me. This was very helpful in orienting myself within the company structure.

2. Being in the Nuclear Fuel Section provided many and varied small projects to work on while also being involved in larger long-term projects. This helped develop the skills necessary to manage time effectively and to work on several projects simultaneously.

3. The necessity for short, concise memos and letters was demonstrated early. Richard gave me ample opportunity to improve and develop my communication skills.

4. I was given many capital expenditure and cash flow analyses to perform in conjunction with fuel cycle cost studies. These were very educational and I feel they contributed greatly to the objectives of the internship.

5. The detailed financial analysis of the proposed second uranium venture with Solution Engineering was also beneficial. This first-hand experience with the financial decision-making process was invaluable.

6. Being involved in the evaluation of the proposals in the Westinghouse litigation provided valuable experience in financial analysis and contract negotiation and administration.

7. The many employee information and training programs which TUSI conducts also contributed to my internship experience. This is especially true of the Project Management Seminar which I attended in February.

I would also like to point out that Richard was extremely cooperative in supervising my internship. His suggestions in developing my internship objectives were most valuable. I feel that he did everything within his power to make my internship a successful one and I sincerely appreciate his efforts.

I hope my comments will be useful in evaluating the internship experience. I would certainly recommend Texas Utilities to other Doctor of Engineering internship candidates and I hope that this program is one in which you will continue to be interested.

Sincerely,

Randy Janne

cc: Richard Calder
Delores Nowlin

VITA

Name:	Randall Lee Janne
Born:	June 25, 1953 - Tyler, Texas
Permanent Address:	5636 Spring Valley Road, #222 Dallas, Texas, 75240
High School:	A&M Consolidated High School, College Station, Texas
University:	Texas A&M University, College Station, Texas: Bachelor of Science in Nuclear Engineering (May 1975); Master of Engineering in Nuclear Engineering (December 1976); Doctor of Engineering (May 1978)
Work Experience:	Associate Engineer, Thermal Analysis Group, Aeroject Nuclear Company, Idaho Falls, Idaho (June 1975 through August 1975); Nuclear Fuels Engineer, Texas Utilities Services Inc., Dallas, Texas (December 1976 through January 1978)
Member:	American Nuclear Society; Tau Beta Pi, National Engineering Honor Society; The Honor Society of Phi Kappa Phi
Honors:	Phi Eta Sigma, Freshman Honor Society; Outstanding Senior, Department of Nuclear Engineering; Outstanding Senior, College of Engineering; Graduate College Merit Fellow

The typist for this report was D. Gail Janne.